

CALIFORNIA POLYTECHNIC STATE UNIVERSITY  
SAN LUIS OBISPO, CALIFORNIA 93407

Comparison of Straight and 15 Degree Vectored  
Nozzles Using a Six Component Thrust Stand

Final Technical Report      10/90-12/91  
NASA-AMES Grant Number      NAG 2-559

Dr. Thomas W. Carpenter, Principle Investigator & Professor

The early testing of straight and 15 degree vectored nozzles using a six component thrust stand was extremely difficult and at times appeared to be impossible. The breakthrough occurred with Scott Flakes work Figure 22, page 40. With the installation of externally pressurized bellows in the air supply the moment produced by a 15 degree vectored nozzle could be differentiated from the straight nozzle. This data indicated that the six component thrust stand worked and that accurate thrust vectored readings were possible. The work of students Scott Flake and Greg Devlin have been included as the final report for NASA Grant NAG 2-559.

Comparison of Straight and 15 Degree  
Vectored Nozzles Using a Six  
Component Thrust Stand

by

Scott Flake

Mechanical Engineering Department  
California Polytechnic State University  
San Luis Obispo  
1991

# TABLE OF CONTENTS

Abstract .....	1
Objectives .....	2
Results .....	2
Discussion	
A. Background .....	3
B. Equipment .....	4
C. Data Reduction .....	7
D. Trial of October 2, 1990 .....	8
E. Trial of December 14, 1990.....	9
F. Trial of December 19, 1990.....	11
G. Zero Thrust Trial .....	11
H. Accuracy of the Stand .....	13
Conclusions .....	16
References .....	18
Appendix A Reference Coordinate System and Sign Convention .....	51
Appendix B Statistical Data .....	55
Appendix C October 2, 1990 Data .....	60
Appendix D December 14, 1990 Data .....	74
Appendix E December 19, 1990 Data .....	104
Appendix F January 24, 1991 Data.....	136
Appendix G Statistical Raw Data .....	145

## List of Tables

Table 1 Summary of Statistical Calculations .....	14
Table 2 Data for the Straight Nozzle October 2, 1990 .....	20
Table 3 Data for the 15° Offset Nozzle October 2, 1990 .....	21
Table 4 Straight Nozzle Data December 14, 1990 .....	23
Table 5 15° Offset Nozzle Data December 14, 1990 .....	24
Table 6 Straight Nozzle Nozzle Data December 19, 1990 .....	33
Table 7 15° Offset Nozzle Nozzle Data December 19, 1990 .....	34
Table 8 Zero Thrust Nozzle Nozzle Data January 24, 1991 .....	34

## List of Figures

Photograph 1 Bellows Evolution .....	5
Photograph 2 Nozzle Types.....	6
Figure 1 December 14, 1990 Comparison of R1 .....	25
Figure 2 December 14, 1990 Comparison of R2 .....	25
Figure 3 December 14, 1990 Comparison of R3 .....	26
Figure 4 December 14, 1990 Comparison of R4 .....	26
Figure 5 December 14, 1990 Comparison of R5 .....	27
Figure 6 December 14, 1990 Comparison of R6 .....	27
Figure 7 December 14, 1990 Comparison of Forces in the X Direction .....	28
Figure 8 December 14, 1990 Comparison of Forces in the Y Direction .....	28
Figure 9 December 14, 1990 Comparison of Forces in the Z Direction .....	29
Figure 10 December 14, 1990 Comparison of Moments in the X Direction .....	30

Figure 11 December 14, 1990 Comparison of Moments in the Y Direction .....	30
Figure 12 December 14, 1990 Comparison of Moments in the Z Direction .....	30
Figure 13 December 19, 1990 Comparison of R1 .....	35
Figure 14 December 19, 1990 Comparison of R2 .....	35
Figure 15 December 19, 1990 Comparison of R3 .....	36
Figure 16 December 19, 1990 Comparison of R4 .....	36
Figure 17 December 19, 1990 Comparison of R5 .....	37
Figure 18 December 19, 1990 Comparison of R6 .....	37
Figure 19 December 19, 1990 Comparison of Forces in the X Direction .....	38
Figure 20 December 19, 1990 Comparison of Forces in the Y Direction .....	38
Figure 21 December 19, 1990 Comparison of Forces in the Z Direction .....	39
Figure 22 December 19, 1990 Comparison of Moments in the X Direction .....	40
Figure 23 December 19, 1990 Comparison of Moments in the Y Direction .....	40
Figure 24 December 19, 1990 Comparison of Moments in the Z Direction .....	41
Figure 25 January 24, 1991 Comparison of R1 .....	44
Figure 26 January 24, 1991 Comparison of R2 .....	44
Figure 27 January 24, 1991 Comparison of R3 .....	45
Figure 28 January 24, 1991 Comparison of R4 .....	45
Figure 29 January 24, 1991 Comparison of R5 .....	46
Figure 30 January 24, 1991 Comparison of R6 .....	46
Figure 31 January 24, 1991 Comparison of Forces in the X Direction .....	38
Figure 32 January 24, 1991 Comparison of Forces in the Y Direction .....	38
Figure 33 January 24, 1991 Comparison of Forces in the Z Direction .....	39
Figure 34 January 24, 1991 Comparison of Moments in the X Direction .....	49
Figure 35 January 24, 1991 Comparison of Moments in the Y Direction .....	49
Figure 36 January 24, 1991 Comparison of Moments in the Z Direction .....	50

## ABSTRACT

This project compared the forces and moments produced by straight and 15 degree vectored nozzles. Using the six component thrust stand in the engines lab at Cal Poly several trials were performed. This data was then reduced using first a computer program and then later an electronic spreadsheet. This reduced data was graphed and compared. As a result of these comparisons some unexpected forces were discovered. Several more tests were run including a zero thrust test and a statistical comparison were done to discover the source of these discrepancies. As a direct result several nozzle changes were made and significant revisions to the thrust stand are being made.

# OBJECTIVES

The objectives of the Senior Project are as follows:

1. Compare the thrust produced by a straight conical nozzle to that of a nozzle offset by 15 degrees.
2. Learn the operation of the FLUKE data acquisition system.
3. Write a computer program to reduce the raw data.
4. Determine the precision of the thrust table.

# RESULTS

1. The results of the test on October 9, 1990 are on pages 19 through 21.
2. The results of the test on December 14, 1990 are on pages 22 through 31.
3. The results of the test on December 19, 1990 are on pages 32 through 41.
4. The results of the test on January 24, 1991 are on pages 42 through 50.
5. The computer program was done on a spreadsheet, and is contained on a Macintosh disk.
6. The program for the FLUKE is with the computer in building 13 engines lab.

## DISCUSSION

### **A. Background**

This project compares the thrust produced by two nozzles. These nozzles are supplied with high pressure air. The maximum pressure supplied is 110 psig. Using the supply valve any pressure can be obtained for testing purposes. As air is supplied to the nozzle a thrust is produced by the nozzle. By mounting the nozzle on a thrust stand the forces and moments can be measured and recorded.

The six component thrust stand is the heart of the system. It is comprised of six load cells. These load cells can measure forces and moments in three dimensions. The ability to measure not only the reactions but the forces and the moments are very valuable. Using this ability I was able to study the effects of the straight, 15 degree offset, and zero thrust nozzles.

The future of the thrust stand includes the mounting of an additional nozzle. This would allow much more testing involving the mixing of the nozzle exhaust, and other applications. All of these combinations can be handled by the thrust stand and the FLUKE data acquisition system currently installed.

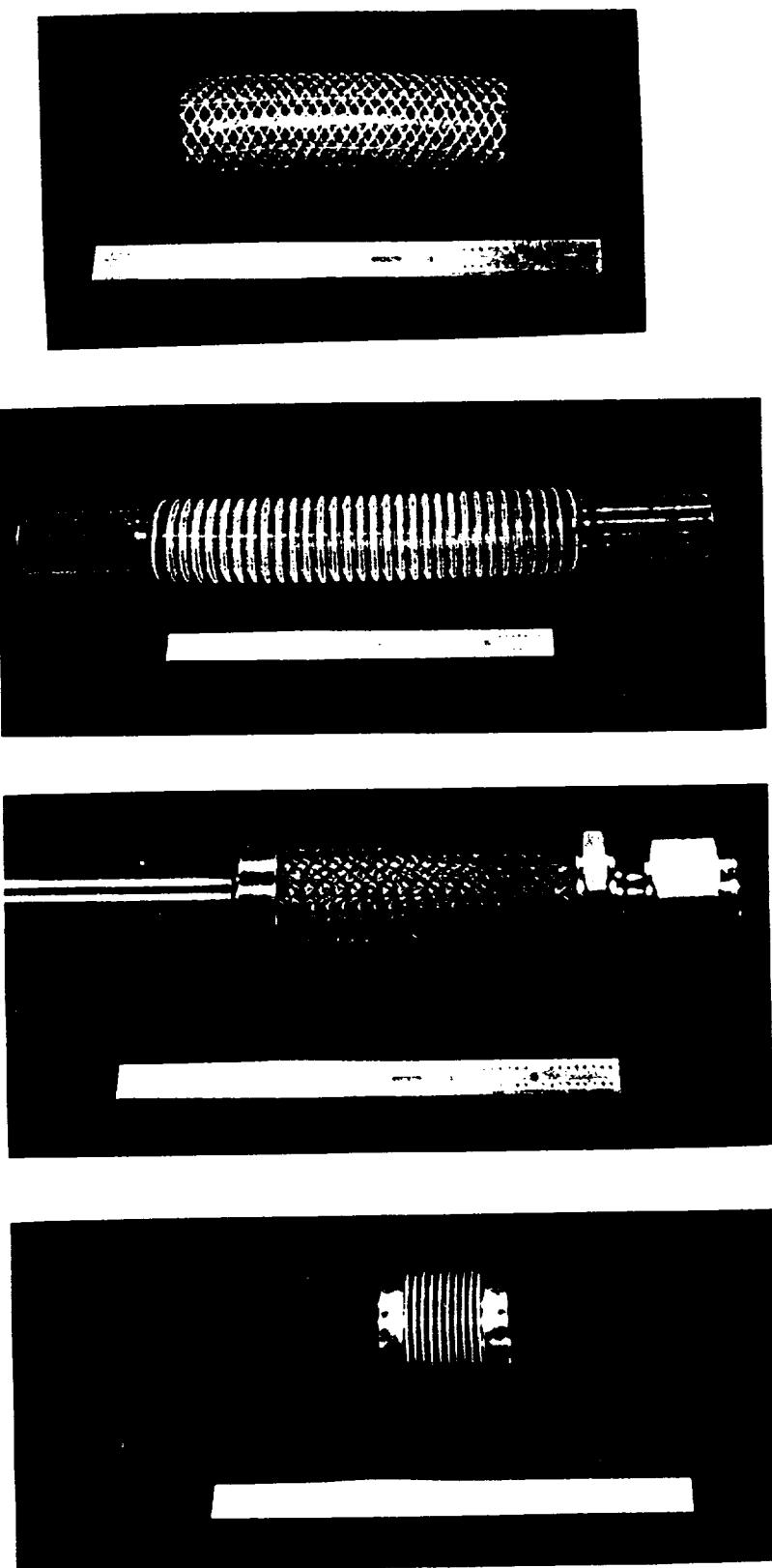
## B. Equipment

This project started with the major pieces of hardware in place. The thrust stand was completed, both the straight and 15 degree nozzles were in place, and the FLUKE data acquisition computer was connected and working. All of this equipment is located in Building's 13 Engines lab. As I started this project the load cell placement and calibration had just been completed and the FLUKE was programmed to read the load cells and pressure transducers. The temperature thermocouples, though physically in place, had not been connected to the FLUKE.

The Thrust Stand load cells are calibrated and attached to the FLUKE. The inlet plenum for a single nozzle was mounted on the Thrust Stand and one nozzle was attached. Either the straight, 15 degree offset, or zero thrust nozzles are available for testing. The inlet plenum was attached to the air supply lines with flexible hose. The entire set-up was mounted on a pedestal setting on the floor. The attachment to the floor was not permanent yet.

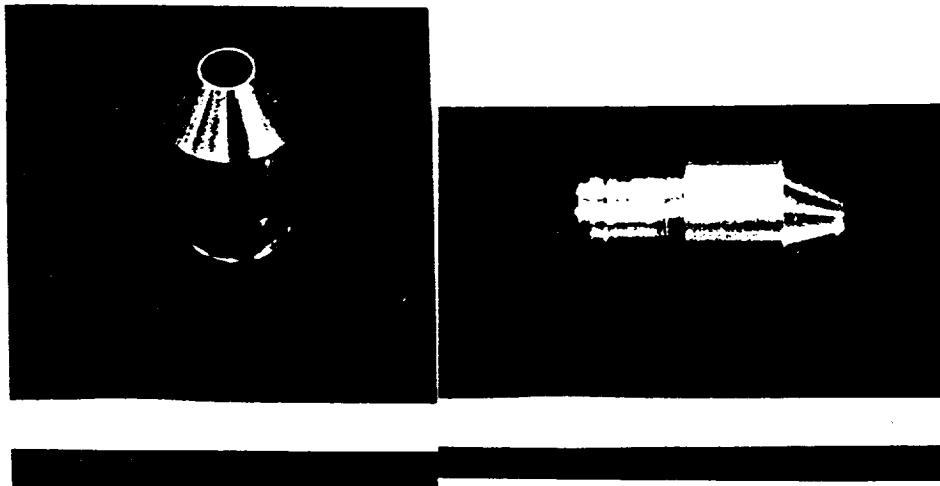
There are three nozzles available for testing on the thrust stand. These nozzles are pictured in Pictures 1 and 2. First the straight nozzle is used for thrust only in the Z axis. It has zero offset. The 15 Degree nozzle is identical to the straight nozzle except that it was cut at a 15 degree angle and welded back together to provide a thrust vectored at 15 degrees. These two nozzles are identical in all other respects. The zero thrust nozzle is used to pressurize the stand for testing purposes.

## Bellows evolution

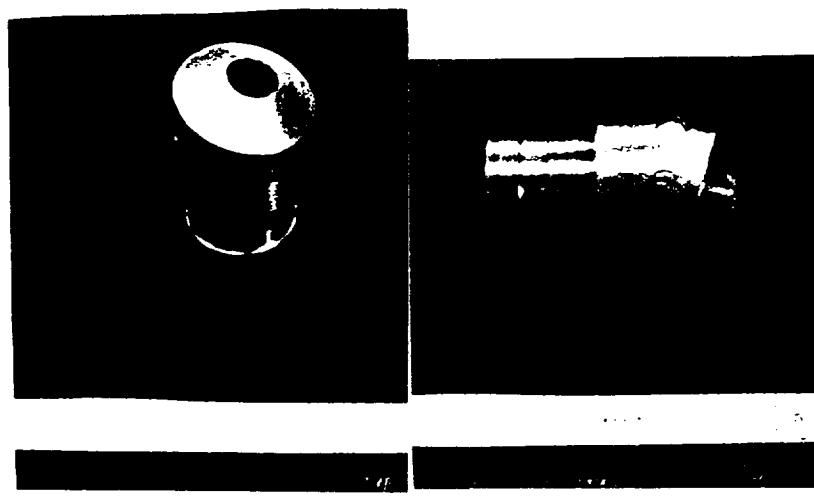


Photograph 1

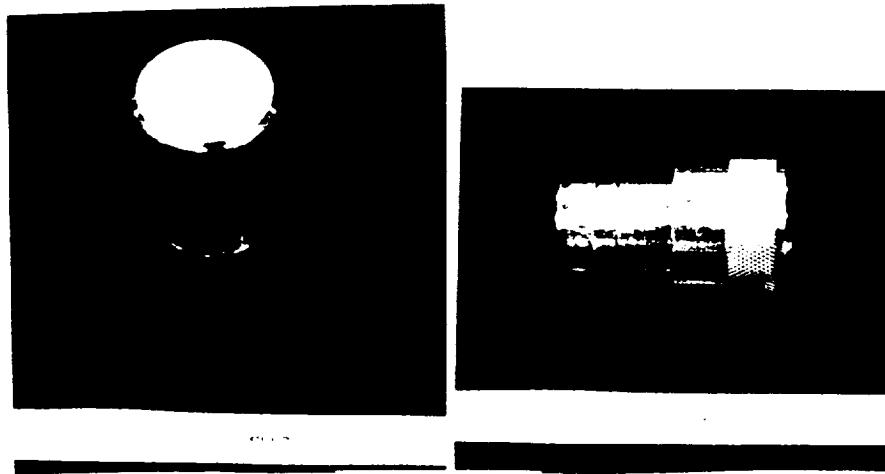
### Straight Nozzle



### 15 Degree Offset Nozzle



### Pressurizing Nozzles



Photograph 2

The data recording is provided by a FLUKE data acquisition computer. The FLUKE is connected to all six load cells and the two pressure transducers. The computer monitors all eight channels and displays the information on a screen. The excitation voltages for all the load cells and transducers are provided by the computer. Using the software provided the information coming into the computer can be manipulated and processed. This additional processing comes at the expense of sample frequency. Because of this the computer was programmed only to give the average of the last seven pressure samples. This information allowed us to determine when steady state had been achieved during testing. When the instantaneous reading matched the average reading, steady state was achieved and a reading was recorded.

### C. Data Reduction

My first objective was to write a program to take the load cell readings displayed on the Fluke and convert them to reactions and moments. The program was written in BASIC so that it could be used on an IBM, which was to be placed in the lab. After the first program was written an error was found in the equations describing the forces and moments. This error was corrected by Don Backlund. The new equations are:

$$FX=R4 \quad (1)$$

$$FY= R5+R6 \quad (2)$$

$$FZ=R1+R2+R3 \quad (3)$$

$$MX=R1*Y1+R2*Y2+R3*Y3 \quad (4)$$

$$MY=R2*X2-R3*X3 \quad (5)$$

$$MZ=R5*X5+R6*X6 \quad (6)$$

Using these new equations, the program was updated. The listing is included in APPENDIX A. Also in APPENDIX A is a diagram showing the directions and sign of each load cell. The new program worked correctly and was written for an IBM and a Macintosh.

As further tests were conducted the program became bulky and slow. The equations were then transferred to a spreadsheet. The spreadsheet consisted of several files. First there was the database. This included all the raw data from the computer printouts. The data from all the trials is stored here for ease of use. Next there are several files for each trial. These files are linked and then the spreadsheet automatically calculates and formats the data.

The data from the spreadsheet is now in table form. The data was then imported into a plotting program called "Cricket Graph" and the plots were generated. This program also calculated Lineal Regressions of the data. This feature became important to me later in determining possible problems in the test stand structure.

#### **D. Trial of October 2,1990**

This was the first trial of the test stand. The data was taken with the flexible hose attached and no bellows. The data from this test

showed that significant work was needed in order to get good data. This data was not plotted but showed clearly that there was a problem with the stand set-up at this point. The forces in the Z direction were higher for the 15° nozzle than for the straight nozzle, and the data was not consistent at the same pressure. From observations during the test it was noted that the hoses had a lot of play in them. As the air pressure increased the hose would flex and push on the test stand. This introduced external forces and interfered with the actual readings. This test prompted us to redesign the air supply arrangement; it was clear that a flexible hose would not work. The idea for a bellows arrangement was brought up here and Don Backlund designed an externally pressurized nozzle to be installed at the intake of the plenum. My idea of a bellows on the output side of the bellows was put on hold because the materials for the inlet bellows had been acquired.

#### E. Trial of December 14, 1990

This run was conducted with a single externally pressurized bellows. From previous testing and observations it was determined that neither the hose nor the convoluted plastic bellows were working. Test runs were conducted on both the straight nozzle and the 15° vectored nozzle. Twenty-one sets of data were taken for each nozzle. This original data can be found in APPENDIX D. Using the revised basic program, the spreadsheet had not been finished yet, the data was converted to reactions and moments. Tables 1 and 2 show this reduced data in table form. From this data a set of curves showing a

comparison between the straight and 15 nozzle were produced.

These curves are shown in Figures 1 through 12. From these curves the data generally had significant scatter, we had hoped for less scatter than the curves indicated we had. Additionally the data wasn't repeatable. Two points in the straight nozzle test  $P=31.6\text{psig}$  and  $P=31.7\text{psig}$  were significantly far apart with the moment in the X direction the worst with a percent difference of 69%. It was concluded that the manifold was exerting a large side load on the test stand and thereby causing faulty data readings in the load cells.

The next step was a detailed investigation of the movements of the manifold and the test stand using a dial indicator. The dial indicator showed the movements of the test stand and the air manifold as they reacted to the forces from the air manifold, the pressurized manifold, and from the nozzle. From this investigation it was discovered that when the test stand was pressurized there indeed was some noticeable loading of the test cells. It has been theorized by Dr. Carpenter that these forces may be due to the bellows being in shear. During this investigation test cell #2 slipped in its holder when loaded. This cell was fixed as best we could by tightening the set screws that secure it, longer mounting wires and additional fasteners are needed to finish the job. Extra supports of the supply pipes were also added. From the previous tests it was determined that additional rigidity was needed.

## F. Trial of December 19, 1990

This trial used a dual bellows arrangement to reduce the data scatter by reducing the side loads, and eliminating the forces caused by the bellows being in shear. Tables 6 and 7 show the reduced data and Figures 13 through 24 show graphically this information.

The first observation was that the data had significantly less scatter when compared to the previous trials. When these two runs were compared with each other the Forces in the Z direction looked the same as the Moments in the X direction. There was a significant improvement in the Moments about the Y axis. These moments are expected to be zero; in the December 14 test they ranged from -2 to -10 in-lbf. With the new bellows installed these moments were reduced to about 1 to -3 in-lbf. Also the moment produced by the straight nozzle in the Z direction was virtually eliminated. The major problem left unsolved was the large moment in the z direction produced by the 15° nozzle. We had hoped for something close to zero. And the small moment in the Y direction, which had been reduced but not eliminated.

## G. Zero Thrust Trial

With the additional improvements on the test stand and the data of the two major tests complete I now wanted to find out how the test

stand reacted to pressurization with no thrust. To do this the zero thrust nozzle was used and eleven readings were taken throughout the test range. These results are located in table 8 and shown in Figures 25 through 36.

Looking at each Force and Moment one at a time the Force in the X direction was very nearly zero with a range of about -0.05 to -0.35 lbf. In the Y direction the force was linear and varied from -2 to -10 lbf. The equation of the line and correlation coefficient are:

$$y = 0.20900 - 0.1051x \quad (7)$$

$$R^2 = 1.000$$

The linearity of this force is surprising because there are so many factors that could affect it. Because it is so linear I think that the bulk of this disturbance is being caused by the bellows. The linearity comes from the fact that its movement is so small a small angle approximation could be applied to the shear in the bellows. This would linearize an equation that had an angle associated with it. The good news is that it is linear so if this effect cannot be removed mechanically it can be removed mathematically using equation 7. The force in the direction was mostly scatter and ranged from -0.05 to -0.4. The force in the Y direction produced a moment in the X direction that was also very nearly linear. The equation and correlation coefficient are:

$$y = 8.089 \text{ e-}2 + 5.3016 \text{ e-}2 x \quad (8)$$

$$R^2 = 0.975$$

This could also be removed mathematically by removing the force in the Y direction. The moment in the Y direction ranged from 0 to 0.4 and was again scatter. The moment in the Z direction was also scatter and ranged from 0.7 to 1.3.

This test showed clearly that there are substantial forces and moments being produced and recorded by our instruments besides the nozzle. Until these external forces are removed the test stand will give erroneous readings and mask what is really going on. The problem was narrowed down to three areas, the first being the nozzle, second the supply piping, and third the accuracy of the readings. From this and the other data it was concluded that the stand needed to be made more rigid. A table is being built to replace the current apparatus; this should help reduce the external forces being introduced into the stand.

## H. Accuracy of the Stand

To test the accuracy of the stand and the instruments ten readings at the same plenum pressure were taken. Four different pressures were used for this test. Using this data the standard deviation and variance were calculated for each load cell. The major assumption that had to be made was that the data followed a normal distribution. There was not enough data to show this distribution and there was not enough time to take enough data to show a normal distribution. This information is collected in Table 1. Using load cell 4 as a typical cell

## Summary of Statistical Calculations

R1	R2	R3	R4	R5	R6
----	----	----	----	----	----

P=12.8 psig

Mean	0.745	0.737	0.681	-0.01	-0.701	-0.563
Variance	0.000539	0.00176	0.00119	0.000244	0.000343	0.000068
Standard Deviation	0.023214	0.0419	0.0345	0.0156	0.0185	0.0082

P=24.5 psig

Mean	1.483	1.343	1.307	-0.015	-1.331	-1.085
Variance	0.000312	0.00069	0.000957	0.00025	0.000277	0.000361
Standard Deviation	0.01767	0.02627	0.0309	0.0158	0.01663	0.019003

P=40.7 psig

Mean	2.455	2.115	2.093	-0.03	-2.192	-1.831
Variance	0.000361	0.00054	0.002112	0.00289	0.00013	0.000343
Standard Deviation	0.019	0.0232	0.04596	0.0537	0.01135	0.01853

P=78.7 psig

Mean	4.726	3.974	3.999	-0.19	-4.283	-3.77
Variance	0.000604	0.003827	0.00243	0.00732	0.000112	0.00015
Standard Deviation	0.0246	0.06186	0.0493	0.08556	0.0106	0.0123

**TABLE 1**

the distribution ranged from 0.0156 at the low pressure of 12.8 psig to 0.08556 at the high pressure of 78.7 psig. As the pressure got higher the standard deviation got larger as did the variance. This was the pattern of all six load cells on the test stand. This shows that the test stand is much more accurate at the lower pressures than at the higher pressures.

## CONCLUSIONS

- 1) The test stand does a good job of showing gross comparisons between the straight and 15° nozzles. By looking at the data from December 19 the moments in the X direction show just how much the 15° vector makes. While the straight nozzle produces essentially a zero moment the 15° vectored nozzle produces a moment of almost 100 in-lbf. The moment produced is linear with an equation of:

$$y = 2.0367 + 1.0489x \quad (9)$$

$$R^2 = 1.000$$

- 2) The test stand has several external forces acting on it. These forces are interfering with our ability to accurately tell what the nozzle is really doing. These anomalies are most apparent in the zero thrust test. Surprisingly these external forces turned out to be linear. The cause of these forces is first the supply piping deflecting as the pressure increases and two the bellows being in shear. By building a new table that will rigidly support the bellows and remove the forces from the supply piping these forces could be virtually removed.
- 3) The test stand works best at low pressures, below about 25 psig in the inlet plenum. The statistical analysis shows that as the pressure increases the variance and the standard deviation

increase rapidly.

Because of this, tests that require the highest accuracy should be limited to 25 psig.

- 4) The thermocouples should be connected and calibrated. With this information additional calculations could be made to determine velocity and then in turn an actual thrust.
- 5) The wires on the load cells need to be a larger diameter and the screws that tighten them need to be larger. Without larger wires and screws the load cells cannot be tightened properly. Load cell 2 was already found to be loose and tightened as much as the allen wrench would allow, which is not enough.

## **REFERENCES**

Avallone, Eugene A. ; Baumeister III, Theodore (1986) "Mark's Standard Handbook for Mechanical Engineers" 9th Edition McGraw-Hill

Edwards, C. H., Jr. ; Penney, David E. (1986) "Calculus and Analytic Geometry" 2nd Edition, New Jersey USA: Prentice-Hall

Hodges, John C. Whitten, Mary E. (1986) "Harbrace College Handbook" 10th Edition, New York: Harcourt Brace Jovanovich

Wark, Kenneth D. (1988) "Thermodynamics" 5th Edition, McGraw-Hill

Weast, Robert C. et al (1974) "CRC Handbook of Chemistry and Physics" 53rd Edition, Cleveland: The Chemical Rubber Company

Results for Tests Performed on  
October 2, 1990

## Data for the Straight Nozzle

Pressure psig	Fx lb	Fy lb	Fz lb	Mx in-lb	My in-lb	Mz in-lb	R1 lb	R2 lb	R3 lb	R4 lb	R5 lb	R6 lb
11.800	0.430	0.210	4.670	-1.025	1.516	7.000	1.420	1.800	1.450	0.430	-0.770	0.980
14.500	0.230	0.410	5.530	-2.050	0.087	7.320	1.570	1.990	1.970	0.230	-0.710	1.120
16.200	-0.190	-0.260	5.280	1.425	-0.563	6.560	1.950	1.600	1.730	-0.190	-0.950	0.690
21.800	0.140	0.360	7.670	-1.925	-0.043	10.000	2.300	2.680	2.690	0.140	-1.070	1.430
23.300	0.190	0.130	7.890	-0.825	0.390	10.440	2.520	2.730	2.640	0.190	-1.240	1.370
23.400	-0.290	-0.300	7.720	1.175	-0.736	9.280	2.730	2.410	2.580	-0.290	-1.310	1.010
26.800	0.180	0.390	9.340	-1.975	1.602	10.600	2.850	3.430	3.060	0.180	-1.130	1.520
28.500	-0.370	-0.440	8.990	2.200	0.346	9.840	3.290	2.890	2.810	-0.370	-1.450	1.010
30.700	0.100	0.150	10.300	-0.625	0.390	12.520	3.350	3.520	3.430	0.100	-1.490	1.640
30.800	0.140	0.390	10.390	-2.350	0.866	11.240	3.150	3.720	3.520	0.140	-1.210	1.600
33.000	-0.260	-0.330	10.700	1.525	0.996	9.000	3.770	3.580	3.350	-0.260	-1.290	0.960
37.900	0.020	0.260	12.580	-1.300	-1.645	16.720	4.020	4.090	4.470	0.020	-1.960	2.220
38.300	0.070	0.510	12.650	-2.825	-0.823	12.760	3.840	4.310	4.500	0.070	-1.340	1.850
39.400	0.080	0.580	13.070	-3.050	-1.559	14.240	3.950	4.380	4.740	0.080	-1.490	2.070
42.900	-0.550	0.160	14.150	-0.950	-1.039	8.720	4.590	4.660	4.900	-0.550	-1.010	1.170
48.300	0.190	1.070	16.410	-5.775	-2.988	12.200	4.700	5.510	6.200	0.190	-0.990	2.060
49.600	-0.740	0.140	16.300	-0.325	-1.256	8.640	5.390	5.310	5.600	-0.740	-1.010	1.150
54.300	0.010	0.890	18.620	-4.325	-4.027	18.120	5.630	6.030	6.960	0.010	-1.820	2.710
59.000	-1.260	-0.100	19.970	0.325	-2.122	13.520	6.700	6.390	6.880	-1.260	-1.740	1.640
61.800	-0.080	1.310	22.220	-6.125	-6.019	19.080	6.590	7.120	8.510	-0.080	-1.730	3.040
64.200	-1.210	0.600	21.270	-2.925	-3.854	14.640	6.700	6.840	7.730	-1.210	-1.530	2.130

TABLE 2

### Data for the 15° offset nozzle

Pressure psig	Fx lb	Fy lb	Fz lb	Mx in-lb	My in-lb	Mz in-lb	R1 lb	R2 lb	R3 lb	R4 lb	R5 lb	R6 lb
9.600	-0.340	0.910	4.040	-16.100	-0.606	7.000	-0.800	2.350	2.490	-0.340	-0.420	1.330
13.800	-1.410	-0.253	0.930	-19.800	-1.645	-0.532	-2.330	1.440	1.820	-1.410	-0.060	-0.193
23.400	-0.050	1.530	8.210	-30.275	2.295	10.040	-1.300	5.020	4.490	-0.050	-0.490	2.020
25.800	0.110	1.290	8.960	-30.875	-1.342	15.400	-1.130	4.890	5.200	0.110	-1.280	2.570
31.000	0.160	1.620	10.520	-36.725	1.689	13.040	-1.390	6.150	5.760	0.160	-0.820	2.440
32.000	-0.140	1.570	11.090	-37.250	-1.212	16.840	-1.270	6.040	6.320	-0.140	-1.320	2.890
35.300	-0.080	1.820	12.170	-41.000	-1.732	15.920	-1.410	6.590	6.990	-0.080	-1.080	2.900
36.700	0.040	1.830	12.330	-42.075	-0.650	17.000	-1.500	6.840	6.990	0.040	-1.210	3.040
39.400	-0.260	2.010	13.500	-45.900	-2.078	17.480	-1.620	7.320	7.800	-0.260	-1.180	3.190
43.900	-0.350	2.430	15.240	-51.900	-2.078	17.960	-1.840	8.300	8.780	-0.350	-1.030	3.460
49.400	-0.130	2.760	16.810	-58.300	-3.204	16.720	-2.170	9.120	9.860	-0.130	-0.710	3.470
50.600	-0.130	2.380	17.150	-56.900	-3.637	20.080	-1.870	9.090	9.930	-0.130	-1.320	3.700
56.200	-0.260	2.430	17.290	-57.625	-4.287	21.640	-1.920	9.110	10.100	-0.260	-1.490	3.920
55.600	-0.460	2.860	19.690	-64.600	-5.629	21.200	-2.050	10.220	11.520	-0.460	-1.220	4.080
59.900	-0.380	2.910	21.090	-68.025	-3.940	21.800	-2.040	11.110	12.020	-0.380	-1.270	4.180
65.700	-0.610	3.680	23.790	-78.675	-10.522	25.120	-2.560	11.960	14.390	-0.610	-1.300	4.980
66.900	-0.570	3.840	24.360	-80.625	-10.349	26.240	-2.630	12.300	14.690	-0.570	-1.360	5.200
67.100	-0.580	3.560	24.520	-79.750	-9.266	26.240	-2.460	12.420	14.560	-0.580	-1.500	5.060
36.9*	-6.310	-0.140	14.460	0.825	-30.007	2.800	4.930	1.300	8.230	-6.310	-0.420	0.280
38.4*	2.030	0.050	14.060	0.925	8.097	6.120	4.810	5.560	3.690	2.030	-0.740	0.790

\* with wedges installed in the bellows

TABLE 3

Results for Tests Performed on  
December 14, 1990

Straight Nozzle Data  
12/14/1990

Pressure psig	Fx lb	Fy lb	Fz lb	Mx in-lb	My in-lb	Mz in-lb	R1 lb	R2 lb	R3 lb	R4 lb	R5 lb	R6 lb
12.9	0.07	2.10	4.42	0.20	-2.25	2.16	1.50	1.20	1.72	0.07	0.78	1.32
14.7	0.02	2.37	5.02	-0.85	-2.16	2.04	1.56	1.48	1.98	0.02	0.93	1.44
17.7	0.11	2.83	5.72	1.83	-2.64	3.40	2.15	1.48	2.09	0.11	0.99	1.84
23	0.00	3.52	7.58	1.98	-3.16	4.16	2.79	2.03	2.76	0.00	1.24	2.28
24.8	0.06	3.75	8.08	2.15	-3.20	4.68	2.98	2.18	2.92	0.06	1.29	2.46
24.6	-0.09	3.73	8.06	2.20	-3.64	4.44	2.98	2.12	2.96	-0.09	1.31	2.42
27.9	0.01	4.18	9.12	2.48	-3.68	5.12	3.37	2.45	3.30	0.01	1.45	2.73
29.7	-0.17	4.38	9.67	1.48	-4.37	4.32	3.42	2.62	3.63	-0.17	1.65	2.73
31.6	0.02	4.64	10.19	2.65	-4.16	5.52	3.75	2.74	3.70	0.02	1.63	3.01
31.7	0.00	4.68	10.17	0.82	-4.11	5.12	3.50	2.86	3.81	0.00	1.70	2.98
34.8	-0.04	5.07	11.38	2.00	-4.68	5.80	4.06	3.12	4.20	-0.04	1.81	3.26
39.9	0.09	5.70	12.83	1.75	-5.46	6.80	4.51	3.53	4.79	0.09	2.00	3.70
40	-0.05	5.70	12.98	1.83	-5.33	6.40	4.57	3.59	4.82	-0.05	2.05	3.65
41.3	0.04	5.83	13.33	1.63	-5.67	7.00	4.66	3.68	4.99	0.04	2.04	3.79
44.7	0.02	6.17	14.47	0.35	-5.89	7.24	4.87	4.12	5.48	0.02	2.18	3.99
50.6	0.03	7.05	16.39	1.33	-6.62	7.88	5.64	4.61	6.14	0.03	2.54	4.51
51.6	0.01	7.07	16.75	0.35	-6.41	7.88	5.63	4.82	6.30	0.01	2.55	4.52
56.6	0.08	7.69	18.45	0.83	-6.62	8.84	6.26	5.33	6.86	0.08	2.74	4.95
61.8	0.07	8.33	20.28	3.67	-7.06	9.56	7.25	5.70	7.33	0.07	2.97	5.36
63.2	0.00	8.50	20.87	0.93	-7.58	9.12	7.08	6.02	7.77	0.00	3.11	5.39
66.6	0.10	8.85	22.08	2.10	-7.79	10.36	7.64	6.32	8.12	0.10	3.13	5.72
84.4	0.09	10.52	28.28	4.07	-6.62	11.52	9.97	8.39	9.92	0.09	3.82	6.70

TABLE 4

15 Degree Nozzle Data  
12/14/1990

Pressure psig	Fx lb	Fy lb	Fz lb	Mx in-lb	My in-lb	Mz lb	R1 lb	R2 lb	R3 lb	R4 lb	R5 lb	R6 lb
9.7	0.04	1.64	3.47	9.78	-2.55	3.44	2.46	0.21	0.80	0.04	0.39	1.25
13.7	0.10	2.12	4.69	11.00	-2.77	4.24	3.03	0.51	1.15	0.10	0.53	1.59
23.7	0.12	3.43	7.78	19.47	-4.20	6.76	5.19	0.81	1.78	0.12	0.87	2.56
25.8	-0.01	3.63	8.38	22.25	-5.02	7.96	5.76	0.73	1.89	-0.01	0.82	2.81
31.1	0.05	4.50	10.08	27.00	-5.89	8.40	6.96	0.88	2.24	0.05	1.20	3.30
31.9	0.14	4.49	10.20	27.07	-5.76	9.40	7.01	0.93	2.26	0.14	1.07	3.42
35.4	0.14	5.10	11.36	32.73	-6.02	10.24	8.15	0.91	2.30	0.14	1.27	3.83
36.7	0.08	5.27	11.87	34.23	-6.45	10.68	8.52	0.93	2.42	0.08	1.30	3.97
38.7	0.06	5.54	12.47	34.53	-7.23	11.04	8.76	1.02	2.69	0.06	1.39	4.15
44.8	0.27	6.22	14.19	39.75	-7.19	12.72	10.03	1.25	2.91	0.27	1.52	4.70
49.1	0.15	6.89	16.02	43.28	-8.36	13.48	11.11	1.49	3.42	0.15	1.76	5.13
51.8	0.22	7.14	16.88	46.52	-8.36	14.40	11.83	1.56	3.49	0.22	1.77	5.37
50.6	0.23	6.99	16.55	43.90	-8.14	13.64	11.37	1.65	3.53	0.23	1.79	5.20
56	0.25	7.70	18.36	50.18	-8.79	15.44	12.81	1.76	3.79	0.25	1.92	5.78
56.2	0.28	7.79	18.34	52.03	-8.53	15.32	13.05	1.66	3.63	0.28	1.98	5.81
59.9	0.18	8.22	19.75	54.65	-9.01	15.76	13.87	1.90	3.98	0.18	2.14	6.08
66.6	0.32	8.94	22.01	60.93	-9.66	17.76	15.46	2.16	4.39	0.32	2.25	6.69
66.1	0.17	8.89	21.99	59.25	-9.87	17.32	15.23	2.24	4.52	0.17	2.28	6.61
67.1	0.27	8.98	22.26	62.03	-9.48	18.56	15.69	2.19	4.38	0.27	2.17	6.81
75.9	0.24	10.07	25.39	70.93	-8.62	19.88	17.92	2.74	4.73	0.24	2.55	7.52
76.6	0.19	10.04	25.59	71.33	-8.70	19.52	18.04	2.77	4.78	0.19	2.58	7.46

TABLE 5

December 14, 1990  
Comparison of R1

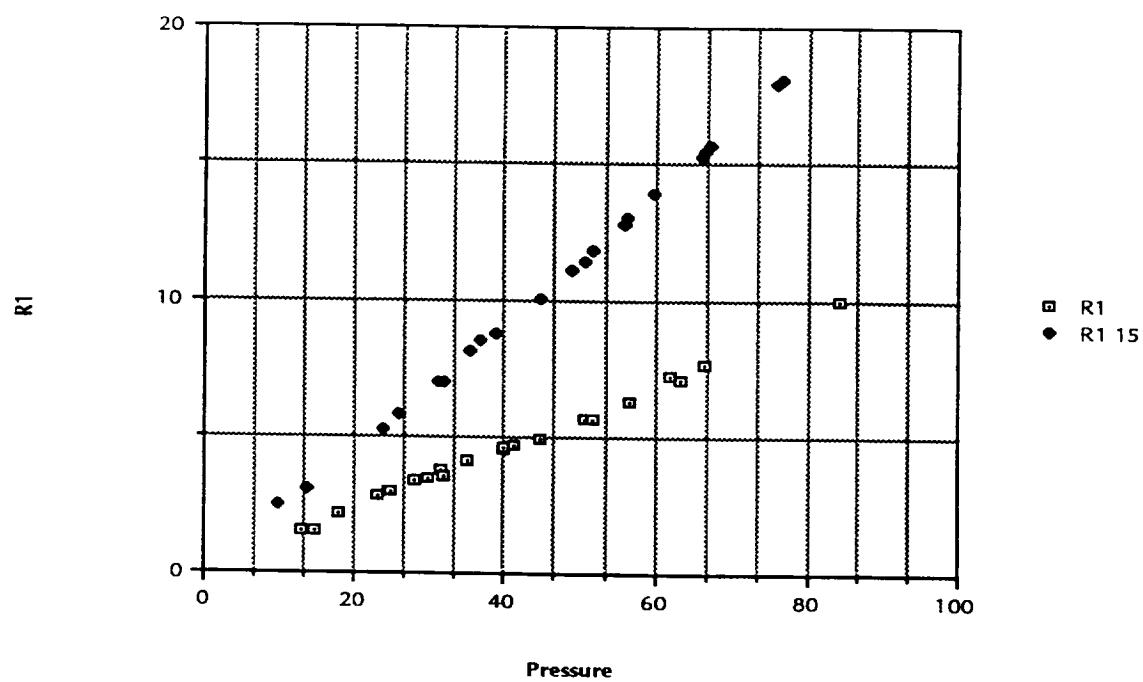


FIGURE 1

December 14, 1990  
Comparison of R2

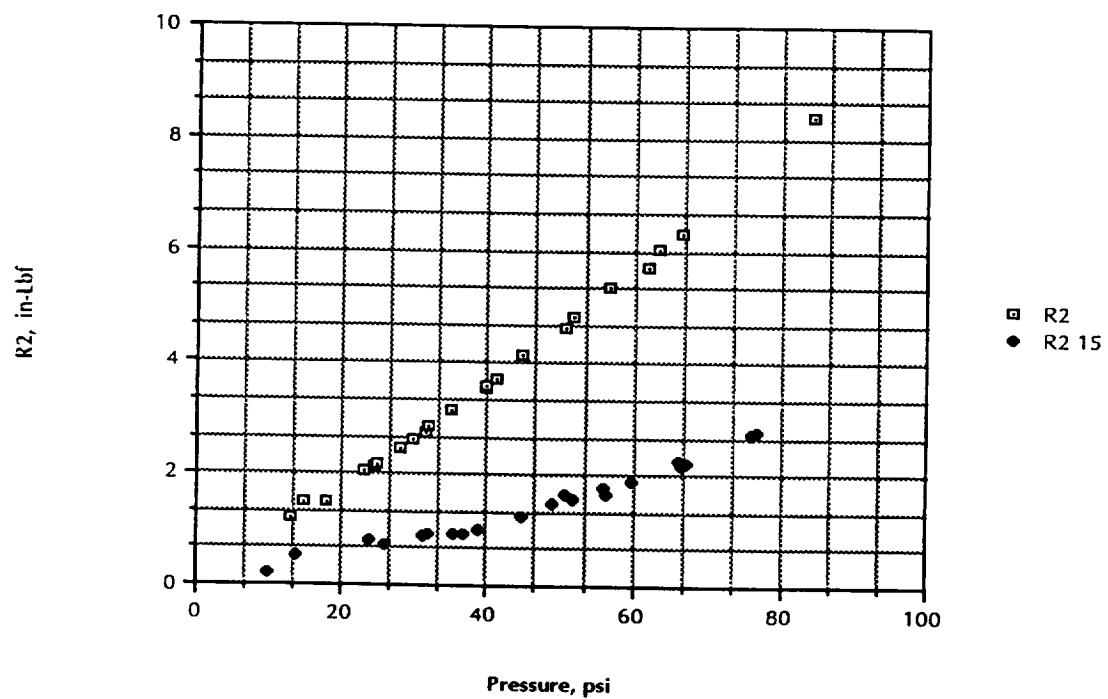


FIGURE 2

December 14, 1990  
Comparison of R3

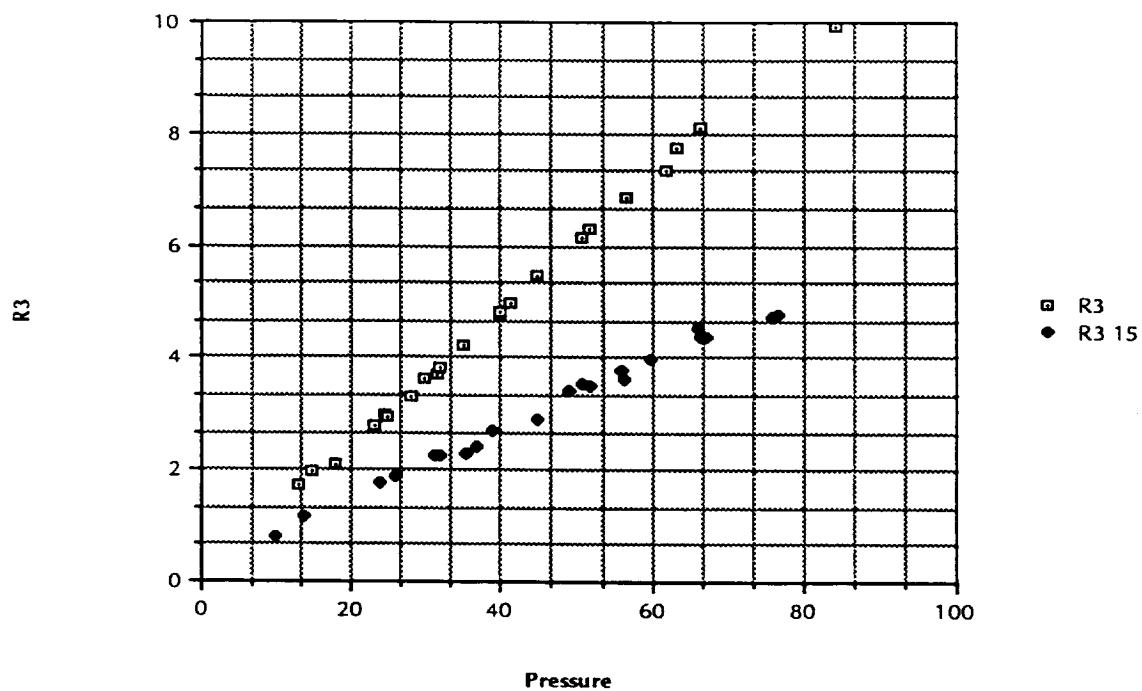


FIGURE 3

December 14, 1990  
Comparison of R4

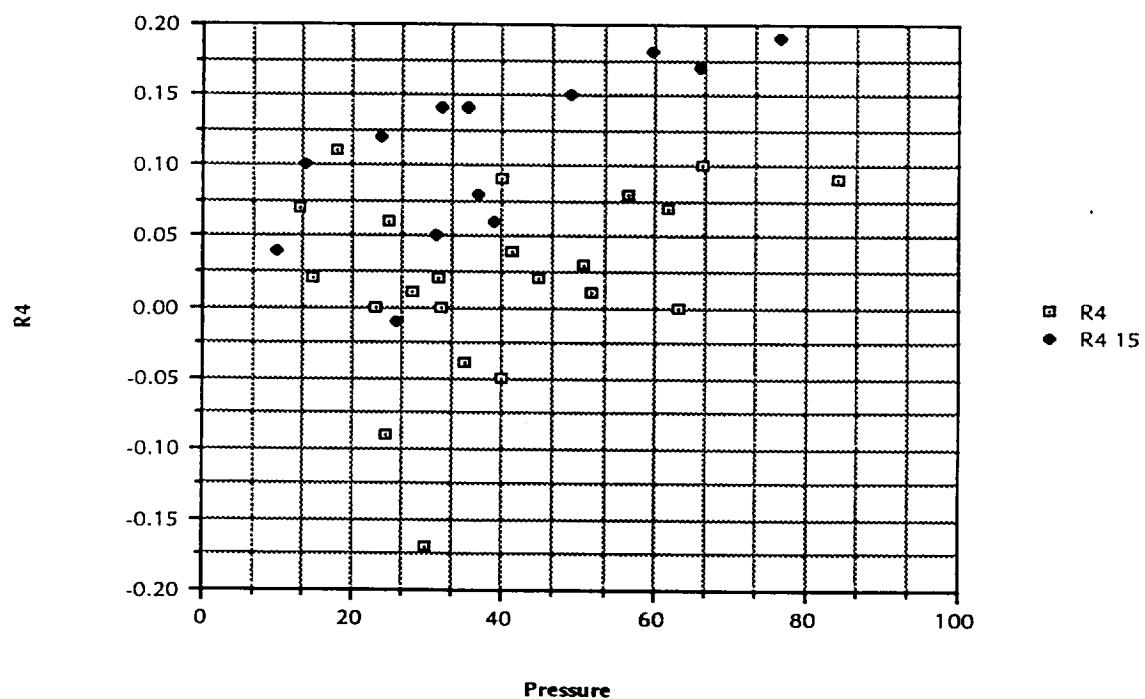
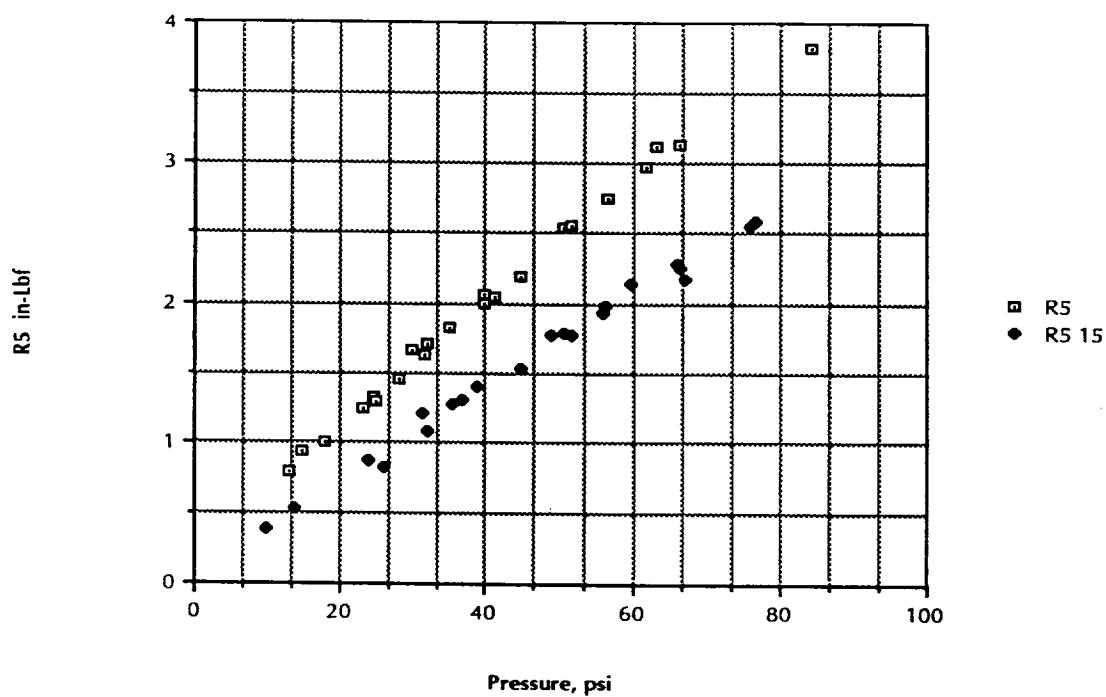
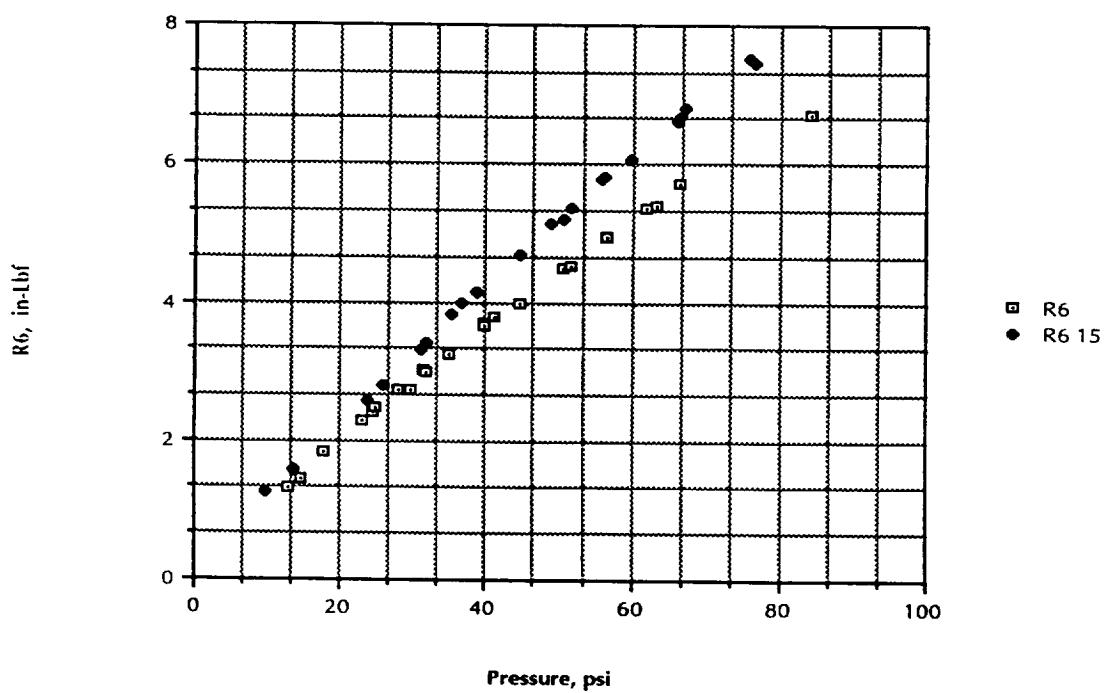


FIGURE 4

**December 14, 1990  
Comparison of R5**

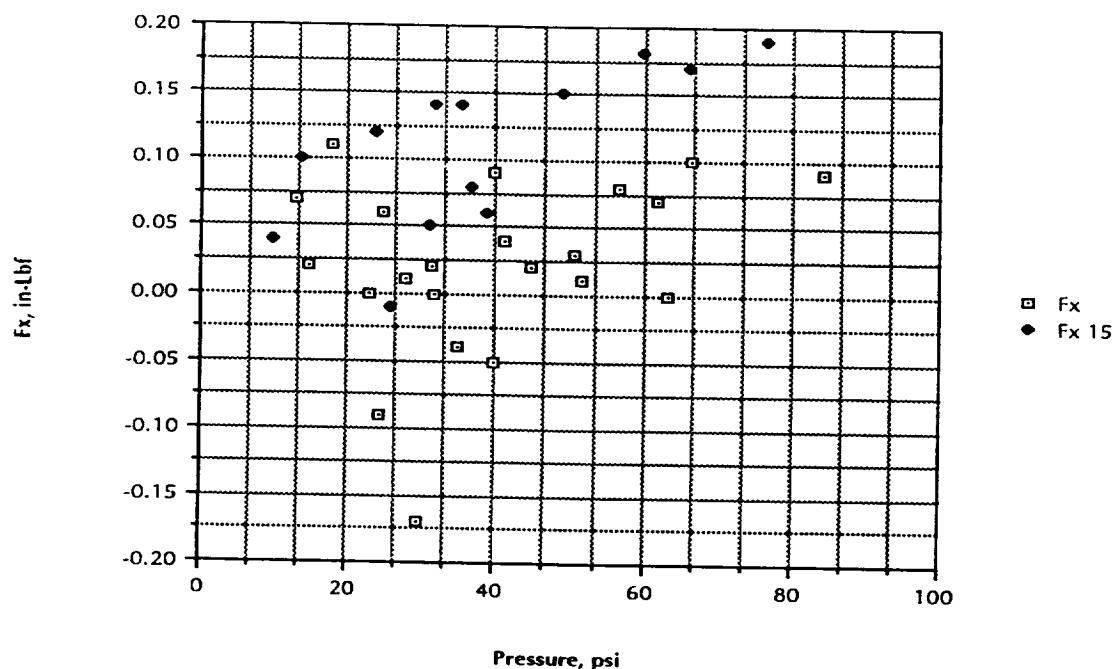


**FIGURE 5  
December 14, 1990  
Comparison of R6**



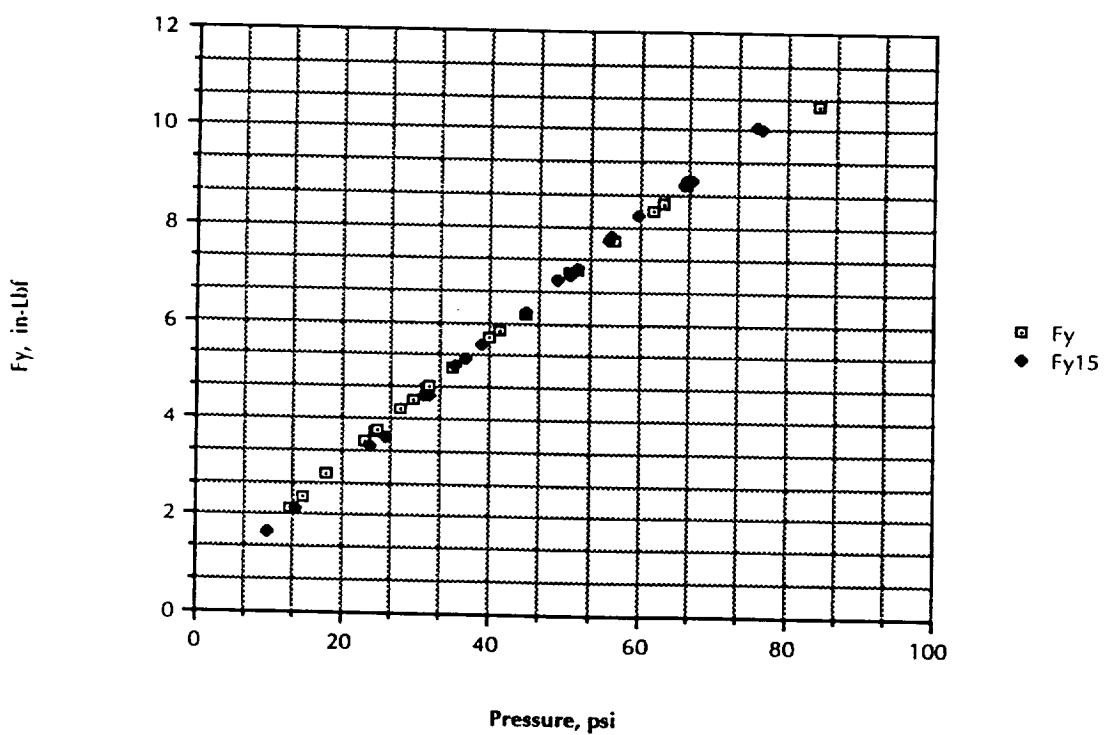
**FIGURE 6**

**December 14, 1990**  
**Comparison of Forces in the X direction**



**FIGURE 7**

**December 14, 1990**  
**Comparison of Forces in the Y direction**



**FIGURE 8**

December 14, 1990  
Comparison of Forces in the Fz Direction

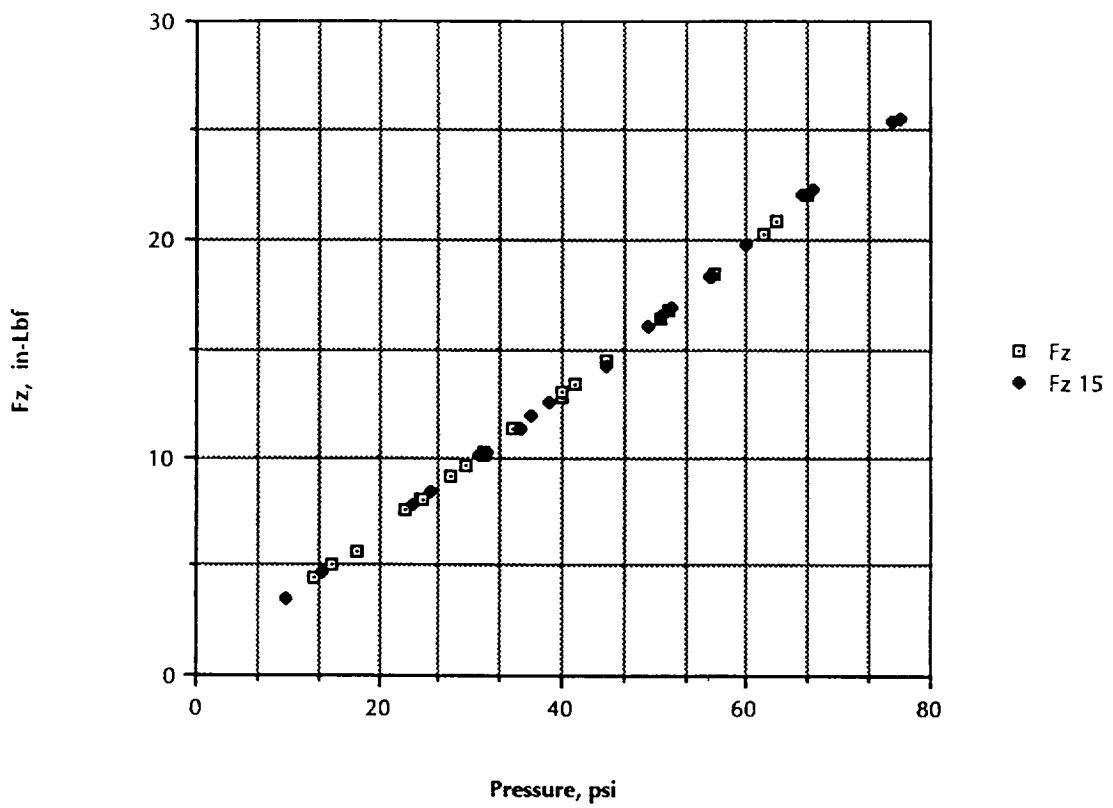
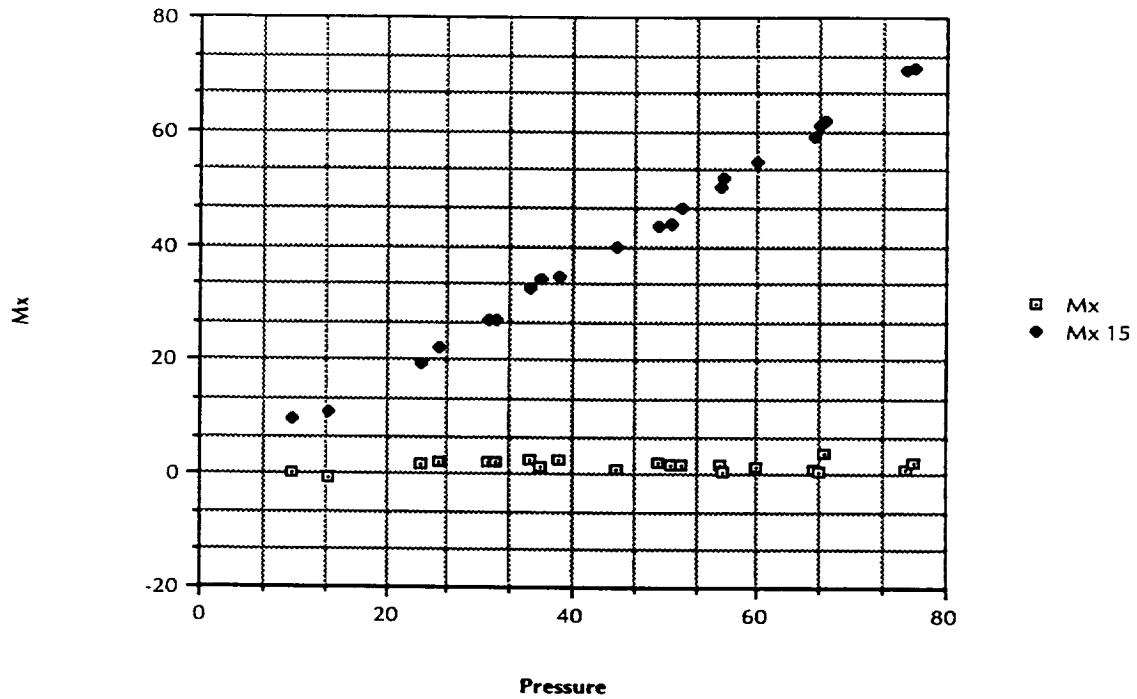


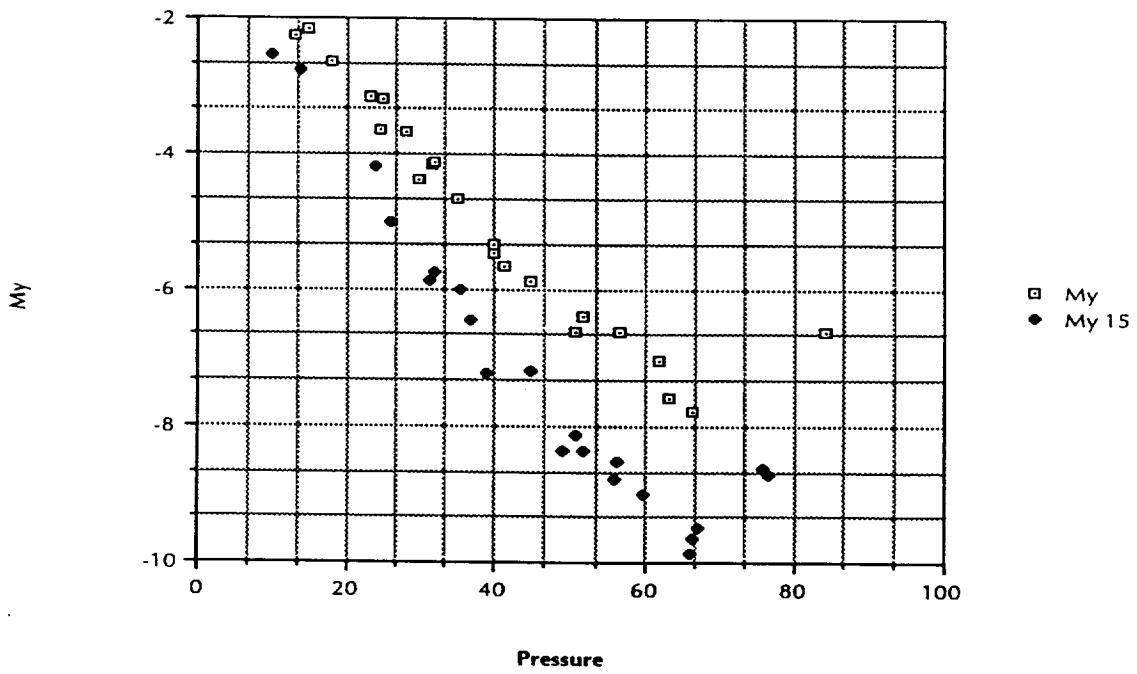
FIGURE 9

**December 14, 1990**  
**Comparison of Moments in the X direction**



**FIGURE 10**

**December 14, 1990**  
**Comparison of Moments about the Y axis**



**FIGURE 11**  
**FIGURE 1**

December 14, 1990  
Comparison of Moments in the Z axis

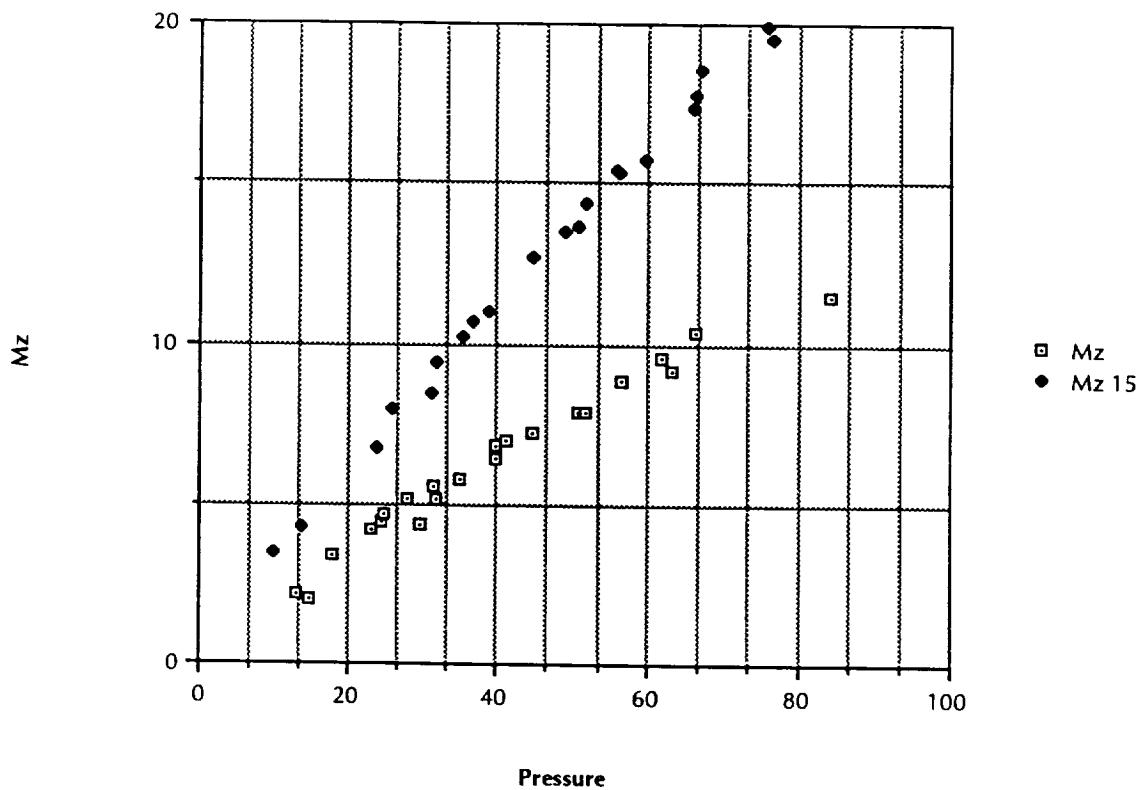


FIGURE 12

Results for Tests Performed on  
December 19, 1990

**Straight Nozzle Data**  
**12/19/1990**

Pressure psig	F <sub>x</sub> lb	F <sub>y</sub> lb	F <sub>z</sub> lb	M <sub>x</sub> in-lb	M <sub>y</sub> in-lb	M <sub>z</sub> in-lb	R <sub>1</sub> lb	R <sub>2</sub> lb	R <sub>3</sub> lb	R <sub>4</sub> lb	R <sub>5</sub> lb	R <sub>6</sub> lb
12.8	0.01	-1.80	2.88	-1.05	0.35	0.64	0.82	1.07	0.99	0.01	-0.98	-0.82
14.8	-0.02	-2.03	3.33	-0.67	0.22	0.60	1.02	1.18	1.13	-0.02	-1.09	-0.94
18	-0.05	-2.37	4.37	-1.55	0.43	0.68	1.25	1.61	1.51	-0.05	-1.27	-1.10
22.7	-0.01	-3.01	5.04	-1.20	0.35	0.84	1.52	1.80	1.72	-0.01	-1.61	-1.40
25.4	-0.02	-3.33	5.28	1.20	0.78	0.84	1.92	1.77	1.59	-0.02	-1.77	-1.56
24.5	-0.02	-3.15	5.52	0.75	0.26	0.84	1.94	1.82	1.76	-0.02	-1.68	-1.47
27.9	0.06	-3.58	6.27	0.98	0.91	0.88	2.22	2.13	1.92	0.06	-1.90	-1.68
29.7	-0.02	-3.85	6.55	1.03	0.56	0.84	2.32	2.18	2.05	-0.02	-2.03	-1.82
32.1	-0.01	-4.16	7.02	1.35	0.52	0.88	2.52	2.31	2.19	-0.01	-2.19	-1.97
32.1	-0.05	-4.14	7.06	1.25	0.35	0.96	2.52	2.31	2.23	-0.05	-2.19	-1.95
35.1	-0.03	-4.51	7.46	1.52	0.56	0.92	2.69	2.45	2.32	-0.03	-2.37	-2.14
39.8	-0.02	-5.16	8.31	2.40	0.35	0.96	3.09	2.65	2.57	-0.02	-2.70	-2.46
40.4	-0.09	-5.21	8.67	1.95	0.17	1.00	3.15	2.78	2.74	-0.09	-2.73	-2.48
41.2	0.02	-5.30	8.77	2.08	0.48	0.96	3.20	2.84	2.73	0.02	-2.77	-2.53
44.6	-0.04	-5.75	9.34	2.30	0.26	1.00	3.42	2.99	2.93	-0.04	-3.00	-2.75
50.7	-0.04	-6.57	10.52	2.80	0.26	1.00	3.88	3.35	3.29	-0.04	-3.41	-3.16
51.7	0.27	-6.70	10.67	3.10	0.87	0.88	3.97	3.45	3.25	0.27	-3.46	-3.24
56.4	-0.06	-7.34	11.78	3.10	0.00	1.12	4.34	3.72	3.72	-0.06	-3.81	-3.53
61.7	-0.08	-8.00	12.48	3.53	-0.22	0.88	4.63	3.90	3.95	-0.08	-4.11	-3.89
63.1	-0.11	-8.18	12.85	3.58	0.04	0.96	4.76	4.05	4.04	-0.11	-4.21	-3.97
66.2	-0.15	-8.58	13.33	3.80	-0.43	1.04	4.95	4.14	4.24	-0.15	-4.42	-4.16
78.7	-0.33	-10.33	15.60	4.65	-0.09	0.84	5.82	4.88	4.90	-0.33	-5.27	-5.06

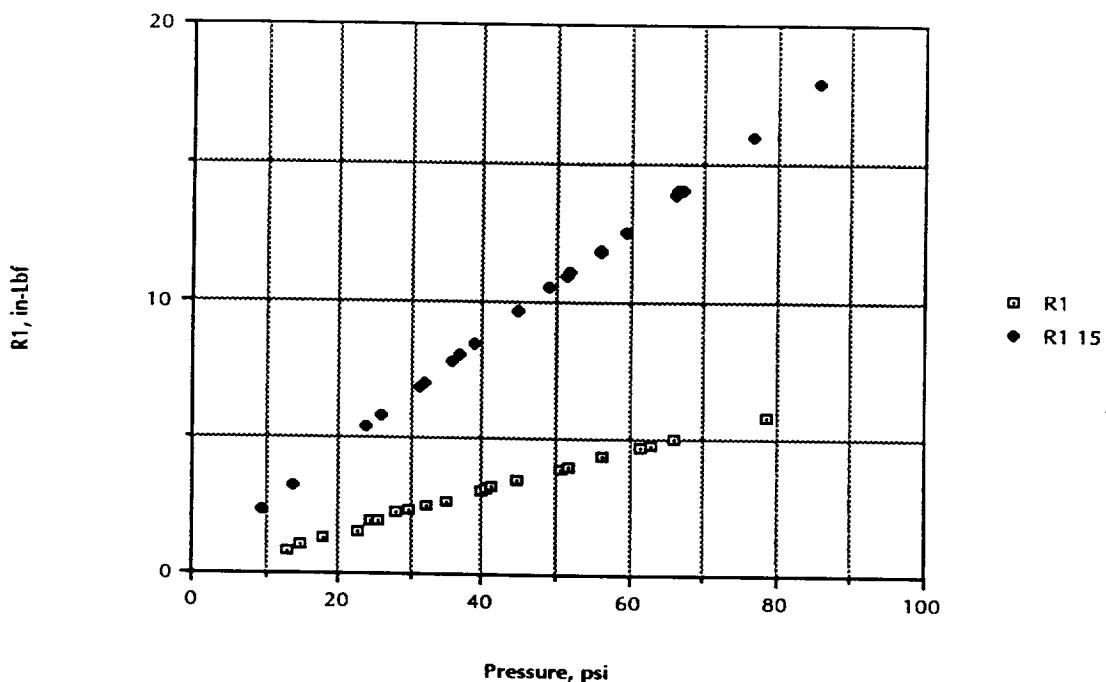
TABLE 6

15 Degree Nozzle Data  
12/19/1990

Pressure psig	F <sub>x</sub> lb	F <sub>y</sub> lb	F <sub>z</sub> lb	M <sub>x</sub> in-lb	M <sub>y</sub> in-lb	M <sub>z</sub> in-lb	R <sub>1</sub> lb	R <sub>2</sub> lb	R <sub>3</sub> lb	R <sub>4</sub> lb	R <sub>5</sub> lb	R <sub>6</sub> lb
9.6	0.10	-1.45	2.30	11.95	-0.43	3.00	2.36	-0.08	0.02	0.10	-1.10	-0.35
13.7	0.08	-1.96	3.21	16.13	-0.48	4.00	3.22	-0.06	0.05	0.08	-1.48	-0.48
23.8	0.14	-3.23	5.25	27.30	-0.78	6.44	5.39	-0.16	0.02	0.14	-2.42	-0.81
25.9	0.12	-3.48	5.59	29.15	-0.78	6.88	5.75	-0.17	0.01	0.12	-2.60	-0.88
31.1	0.15	-4.15	6.60	34.88	-0.65	8.12	6.85	-0.20	-0.05	0.15	-3.09	-1.06
31.7	0.15	-4.23	6.70	35.45	-0.95	8.28	6.96	-0.24	-0.02	0.15	-3.15	-1.08
35.8	0.17	-4.73	7.59	39.60	-0.95	9.08	7.81	-0.22	0.00	0.17	-3.50	-1.23
36.7	0.15	-4.89	7.78	40.63	-1.34	9.32	8.01	-0.27	0.04	0.15	-3.61	-1.28
38.8	0.08	-5.14	8.12	43.08	-0.91	9.84	8.45	-0.27	-0.06	0.08	-3.80	-1.34
44.7	0.14	-5.91	9.28	48.95	-1.04	11.08	9.62	-0.29	-0.05	0.14	-4.34	-1.57
49.1	0.03	-6.45	10.10	53.65	-1.30	12.12	10.52	-0.36	-0.06	0.03	-4.74	-1.71
51.8	0.07	-6.89	10.63	56.30	-1.39	12.76	11.05	-0.37	-0.05	0.07	-5.04	-1.85
51.4	0.07	-6.82	10.49	55.68	-1.52	12.64	10.92	-0.39	-0.04	0.07	-4.99	-1.83
55.9	0.10	-7.29	11.24	60.25	-1.56	13.64	11.78	-0.45	-0.09	0.10	-5.35	-1.94
56	0.07	-7.42	11.35	60.88	-1.34	13.60	11.90	-0.43	-0.12	0.07	-5.41	-2.01
59.5	0.03	-7.88	11.81	64.23	-1.43	14.40	12.50	-0.51	-0.18	0.03	-5.74	-2.14
66.6	0.01	-8.88	13.39	72.13	-1.95	15.92	14.08	-0.57	-0.12	0.01	-6.43	-2.45
66.1	0.06	-8.81	13.27	71.23	-1.95	15.80	13.92	-0.55	-0.10	0.06	-6.38	-2.43
67.1	0.14	-8.94	13.36	72.13	-2.29	15.92	14.07	-0.62	-0.09	0.14	-6.46	-2.48
76.4	0.12	-10.28	15.17	82.08	-2.99	17.92	16.00	-0.76	-0.07	0.12	-7.38	-2.90
85.8	0.07	-11.58	16.89	92.40	-3.29	19.84	17.95	-0.91	-0.15	0.07	-8.27	-3.31

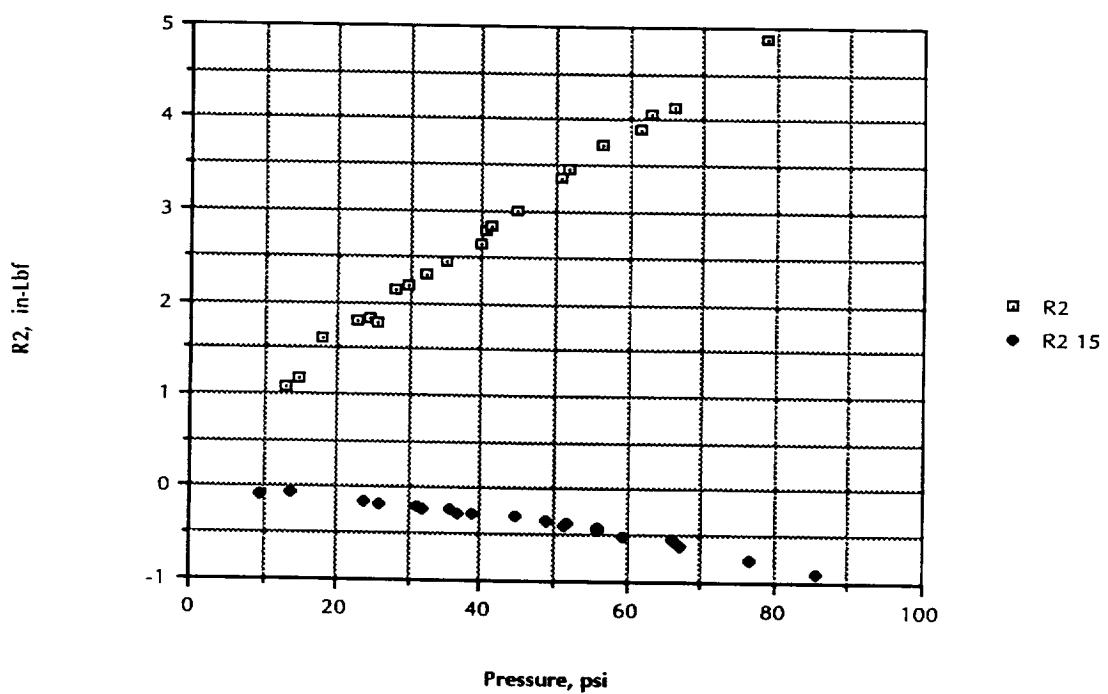
TABLE 7

**December 19, 1990**  
**Comparison of load cell 1**



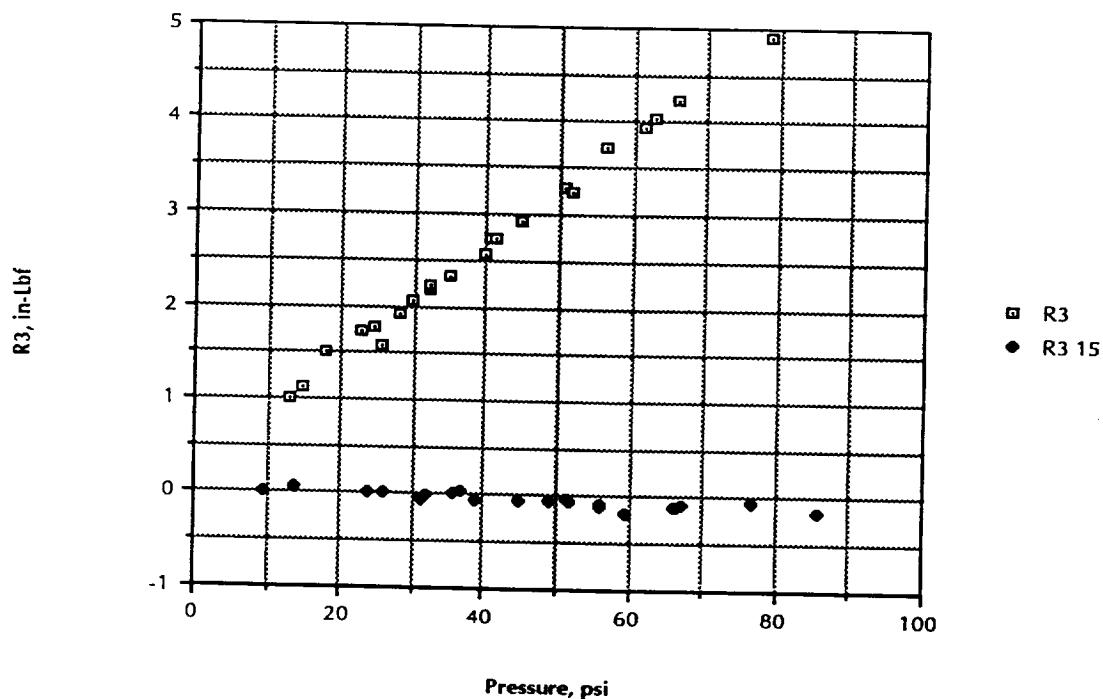
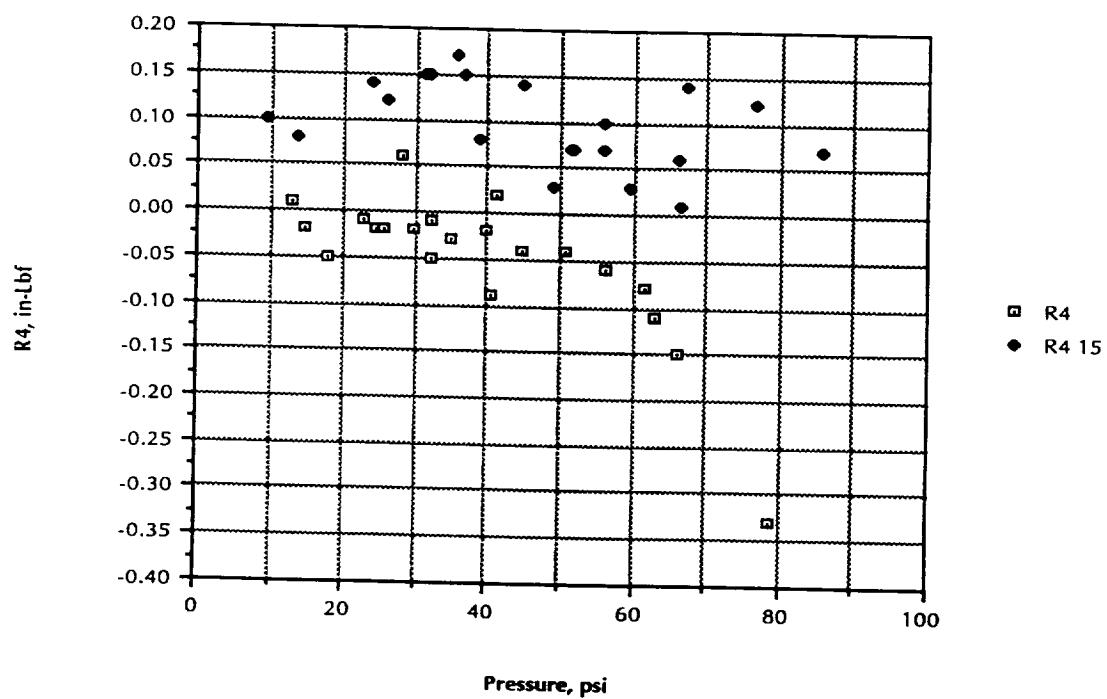
**FIGURE 13**

**December 19, 1990**  
**Comparison of load cell 2**

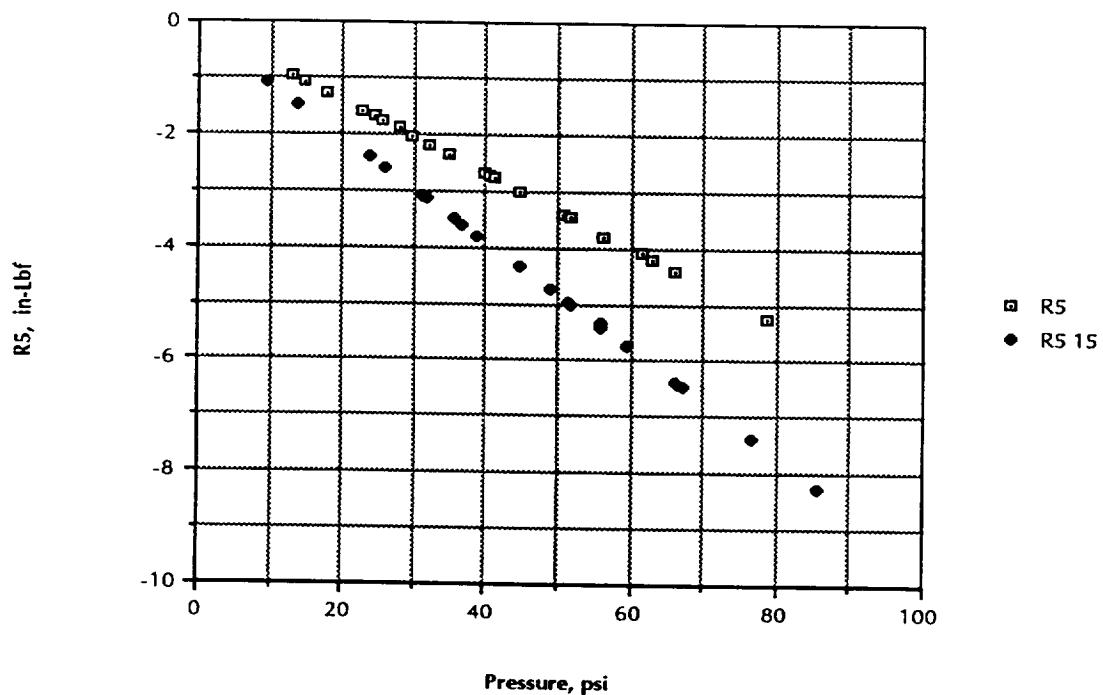


**FIGURE 14**

**December 19, 1990**  
**Comparison of load cell 3**

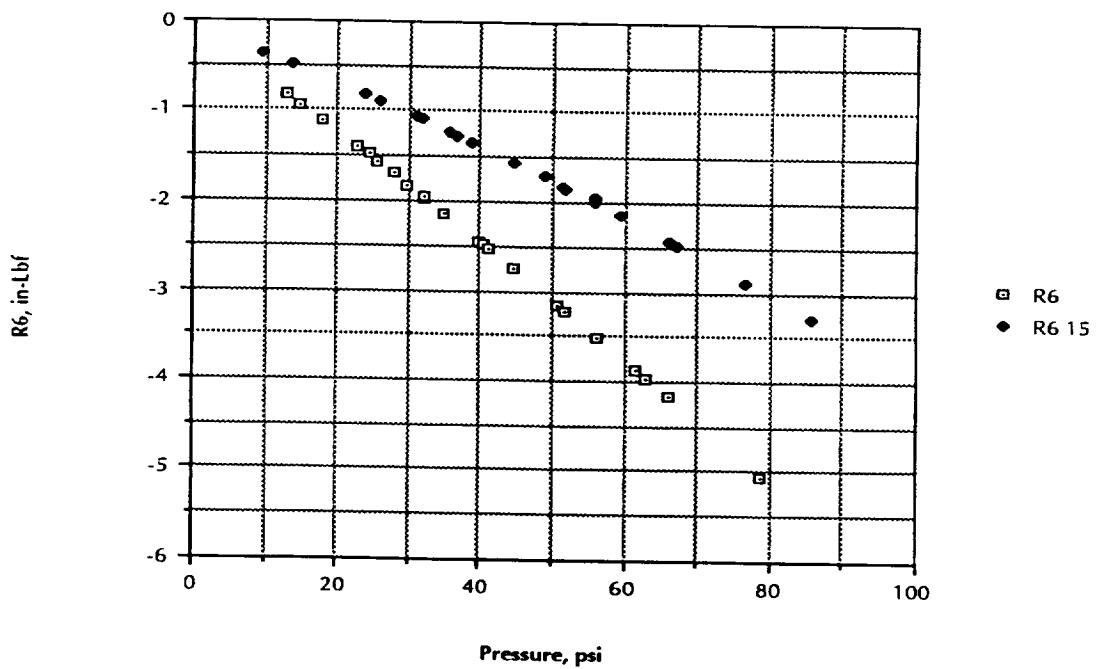
**FIGURE 15****Comparison of load cell 4****FIGURE 16**

**December 19, 1990**  
**Comparison of load cell 5**



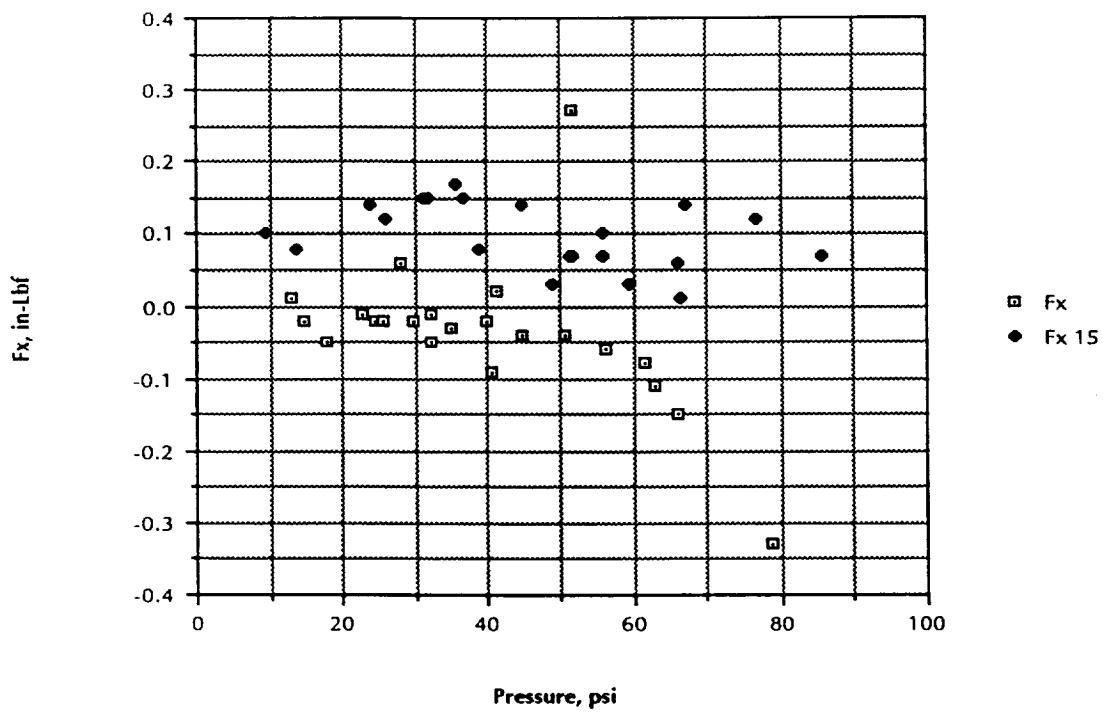
**FIGURE 17**

**December 19, 1990**  
**Comparison of load cell 6**



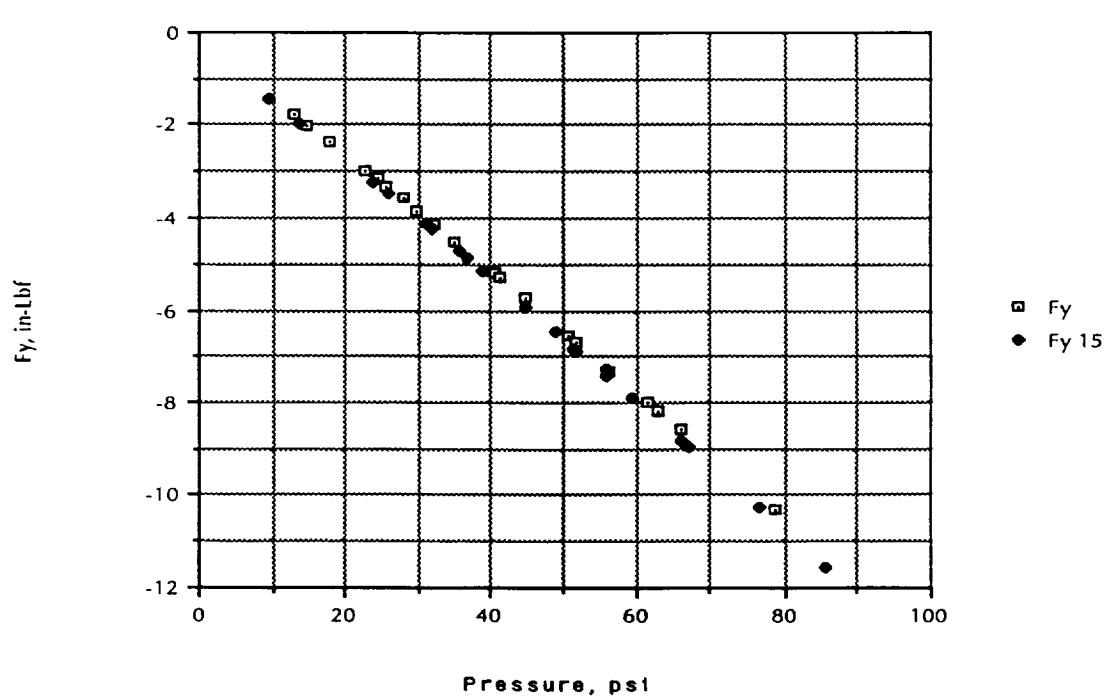
**FIGURE 18**

**December 19, 1990**  
**Comparison of Forces in the X direction**



**FIGURE 19**

**December 19, 1990**  
**Comparison of Forces in the Y direction**



**FIGURE 20**

December 19, 1990  
Comparison of Forces in the Z direction

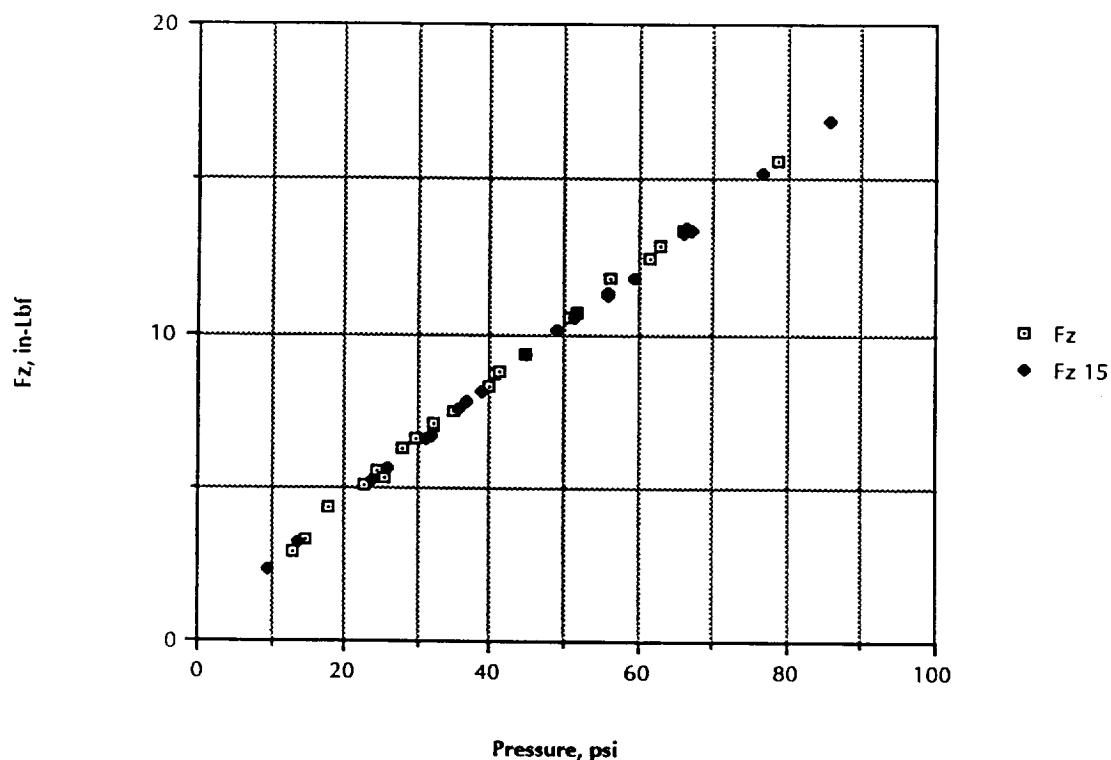


FIGURE 21

December 19, 1990  
Comparison of Moments in the X direction

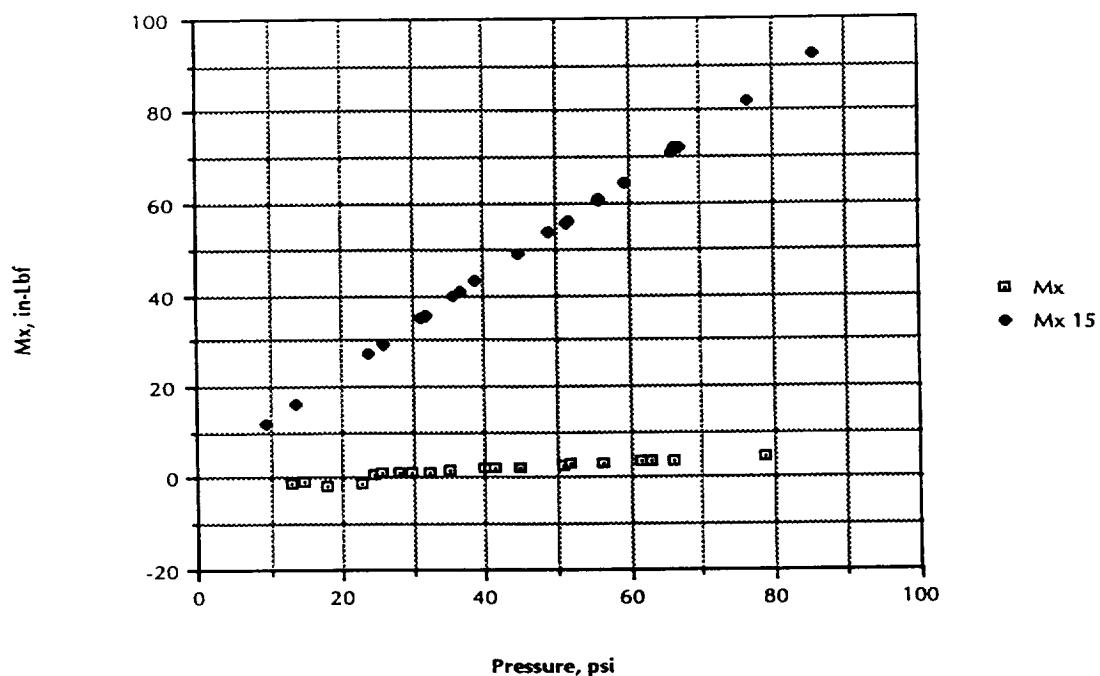


FIGURE 22

December 19, 1990  
Comparison of Moments in the Y direction

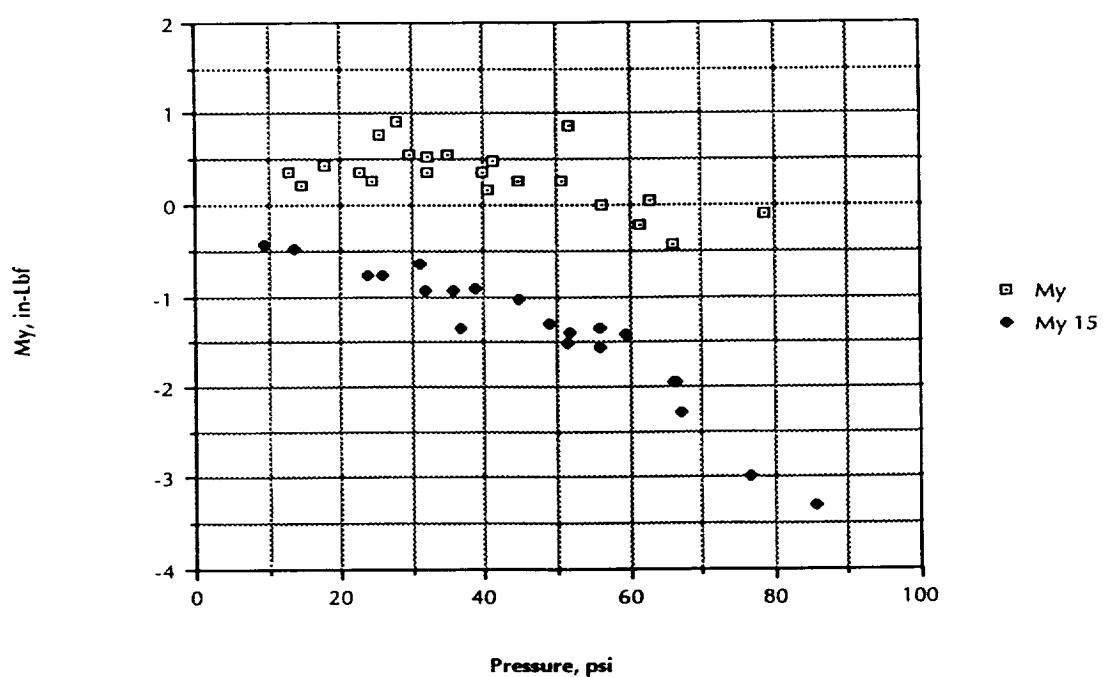
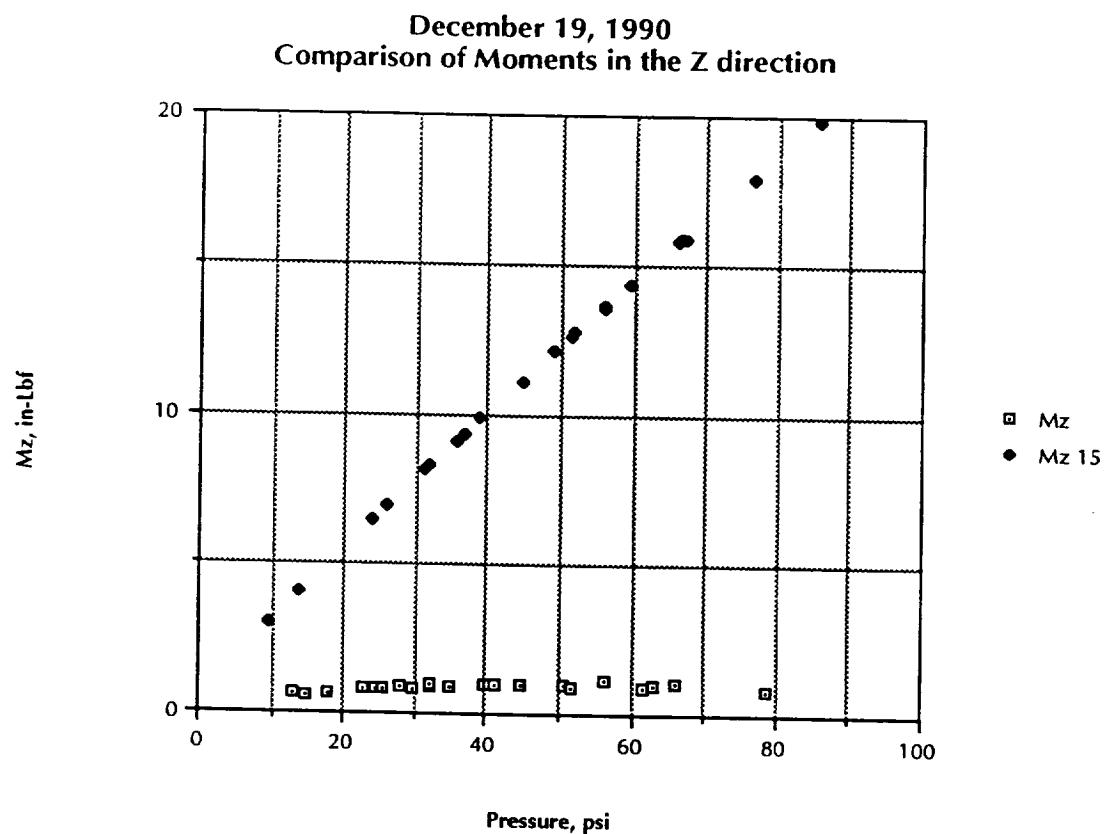


FIGURE 23FIGURE 20



**FIGURE 24****FIGURE 20**

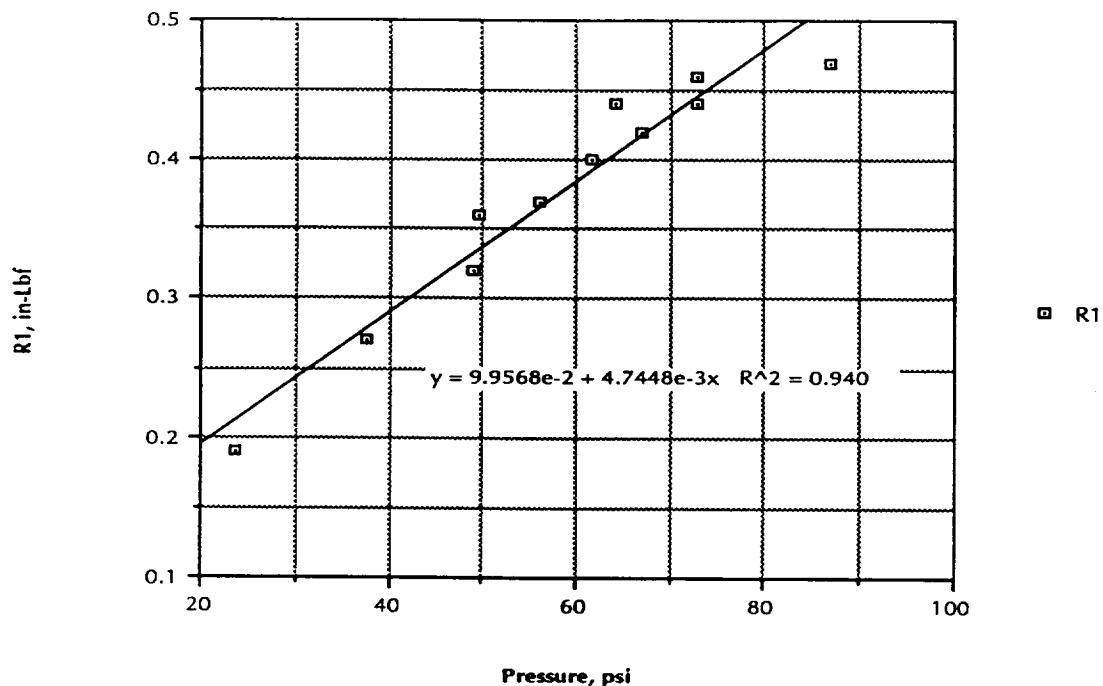
Results for Tests Performed on  
January 24, 1991

Zero Thrust Nozzle Data  
1/24/1991

Pressure psig	Fx lb	Fy lb	Fz lb	Mx in-lb	My in-lb	Mz in-lb	R1 lb	R2 lb	R3 lb	R4 lb	R5 lb	R6 lb
23.5	-0.09	-2.30	0.05	1.30	0.17	0.72	0.19	-0.05	-0.09	-0.09	-1.24	-1.06
37.7	-0.07	-3.76	0.02	1.97	0.30	1.04	0.27	-0.09	-0.16	-0.07	-2.01	-1.75
49.1	-0.11	-4.92	-0.07	2.58	0.22	1.12	0.32	-0.17	-0.22	-0.11	-2.60	-2.32
49.7	-0.11	-4.99	-0.06	2.85	0.26	1.24	0.36	-0.18	-0.24	-0.11	-2.65	-2.34
56	-0.13	-5.67	-0.12	3.08	0.22	1.24	0.37	-0.22	-0.27	-0.13	-2.99	-2.68
61.6	-0.16	-6.25	-0.15	3.38	0.13	1.24	0.40	-0.26	-0.29	-0.16	-3.28	-2.97
64.3	-0.27	-6.55	-0.06	3.45	0.17	1.24	0.44	-0.23	-0.27	-0.27	-3.43	-3.12
67	-0.20	-6.83	-0.20	3.65	0.00	1.24	0.42	-0.31	-0.31	-0.20	-3.57	-3.26
73	-0.15	-7.47	-0.39	4.27	0.39	1.24	0.44	-0.37	-0.46	-0.15	-3.89	-3.58
73	-0.24	-7.46	-0.21	3.98	0.22	1.28	0.46	-0.31	-0.36	-0.24	-3.89	-3.57
86.8	-0.33	-8.95	-0.35	4.40	0.00	1.16	0.47	-0.41	-0.41	-0.33	-4.62	-4.33

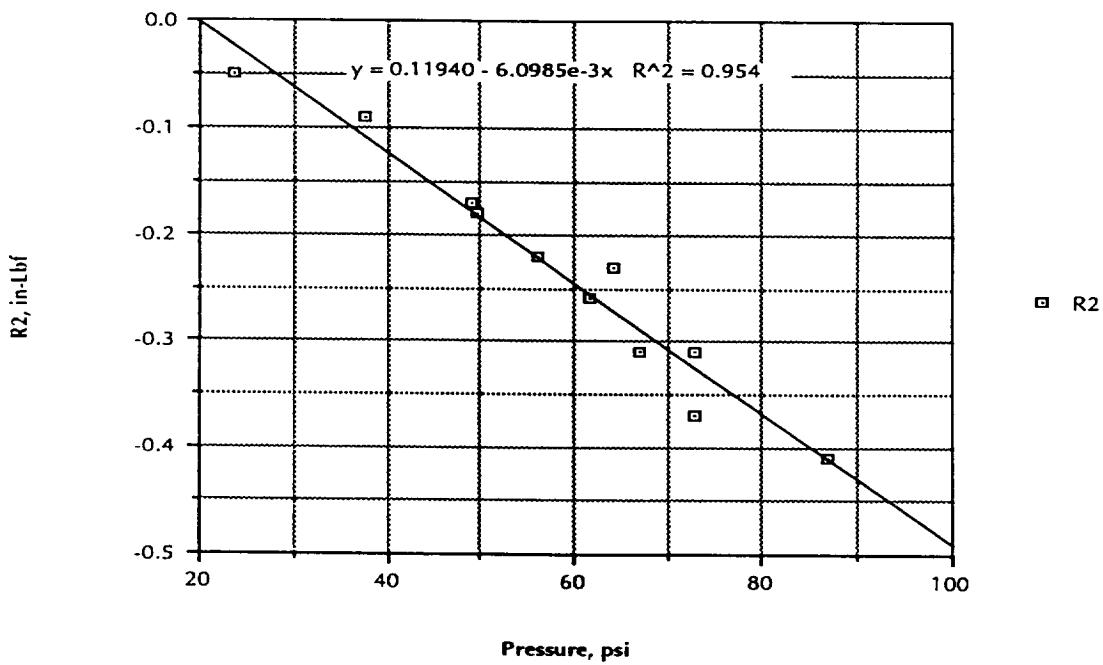
TABLE 8

**Load cell 1**  
January 24, 1991



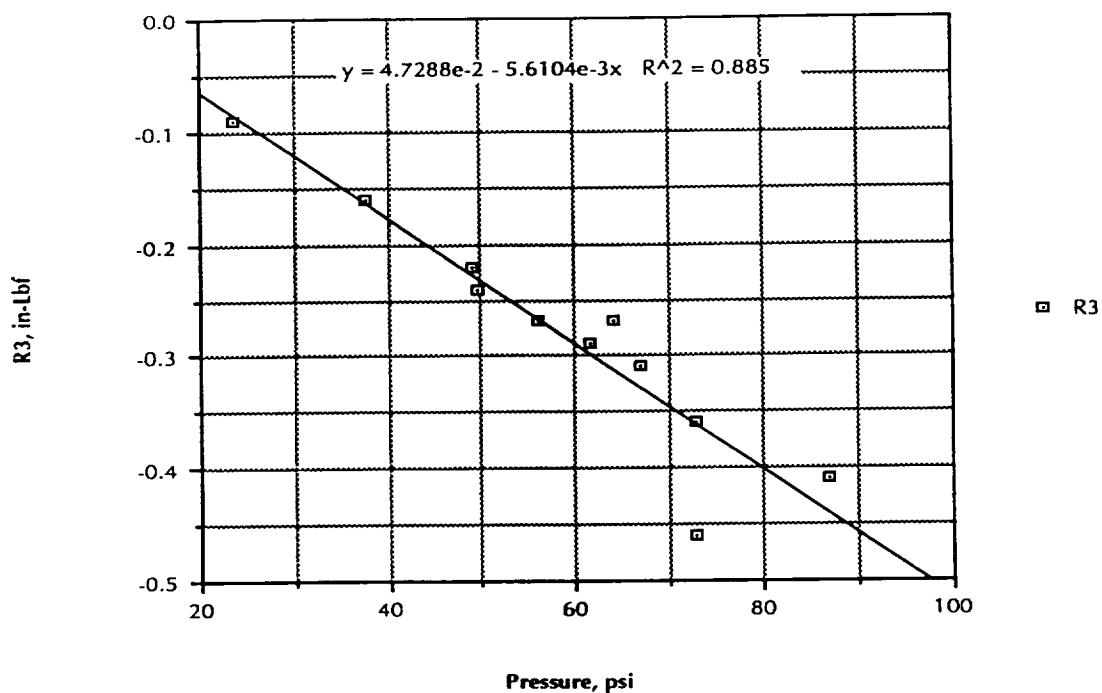
**FIGURE 25**

**Load cell 2**  
January 24, 1991



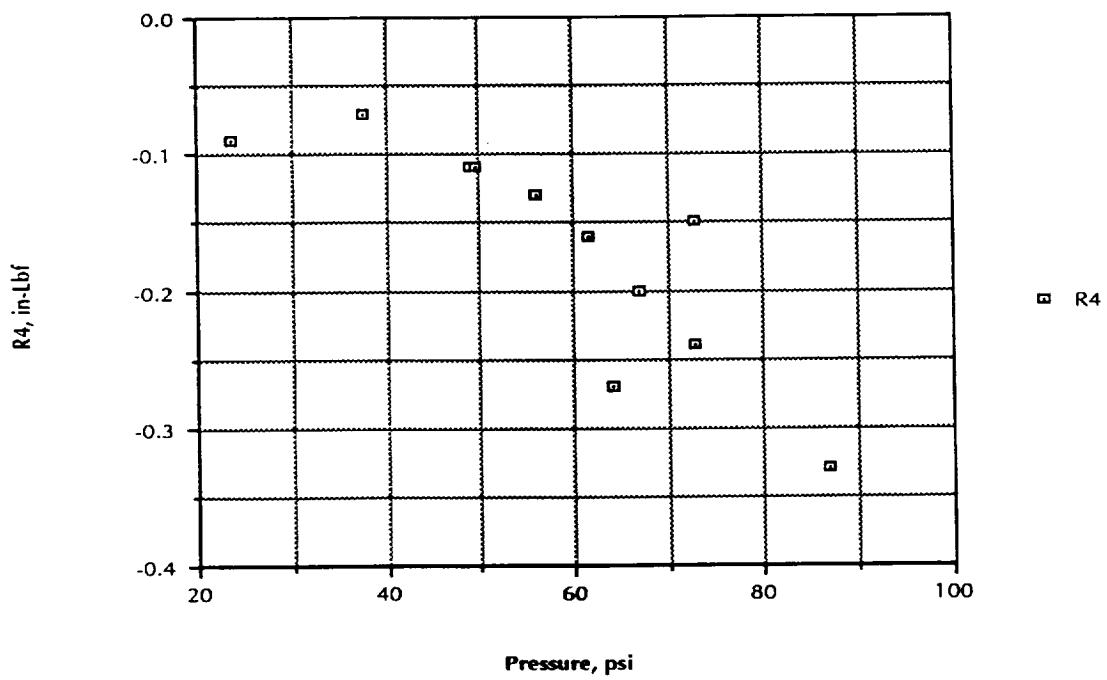
**FIGURE 26**  
**FIGURE 20**

**Load cell 3**  
January 24, 1991

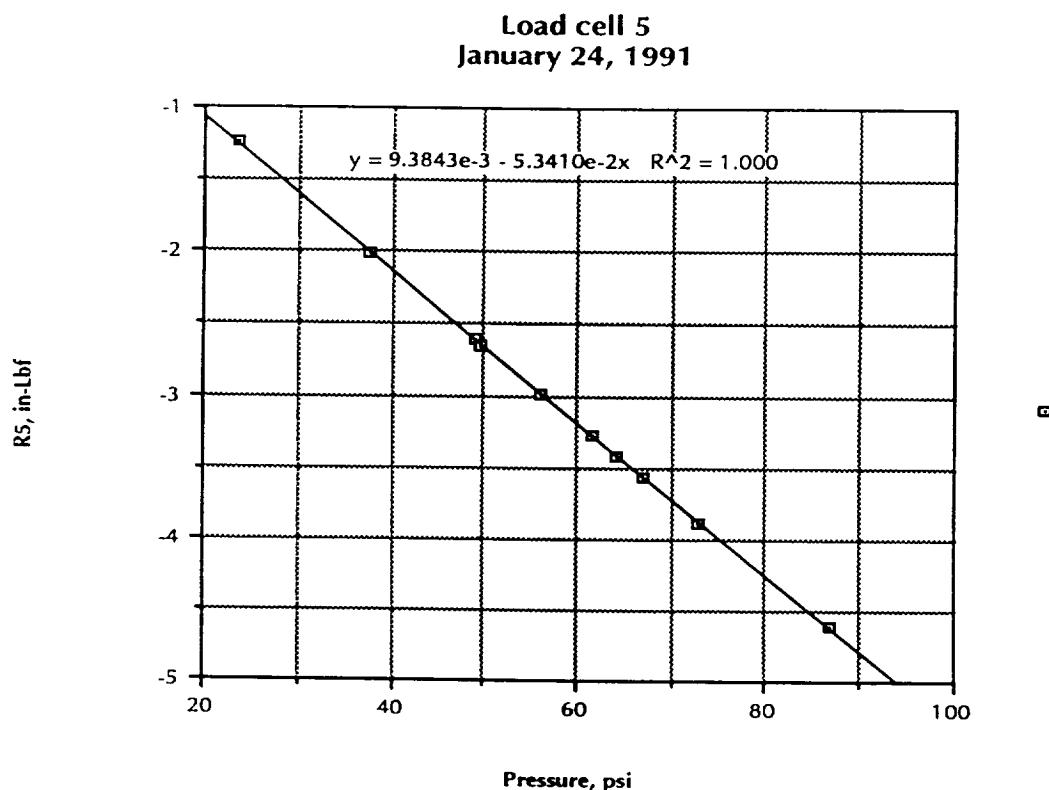
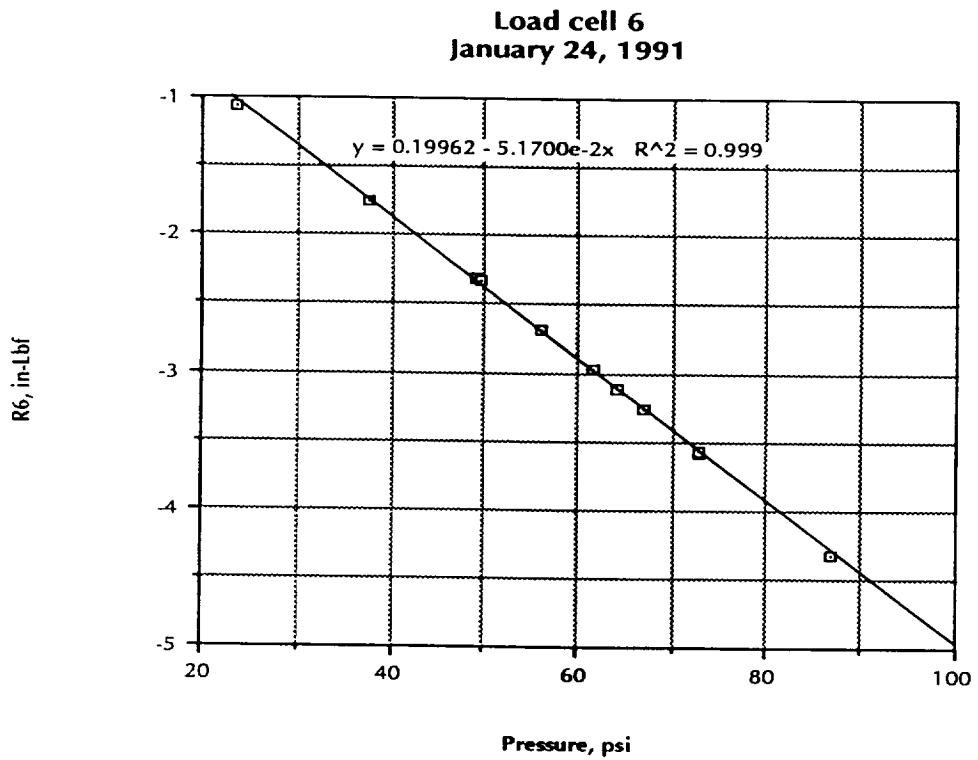


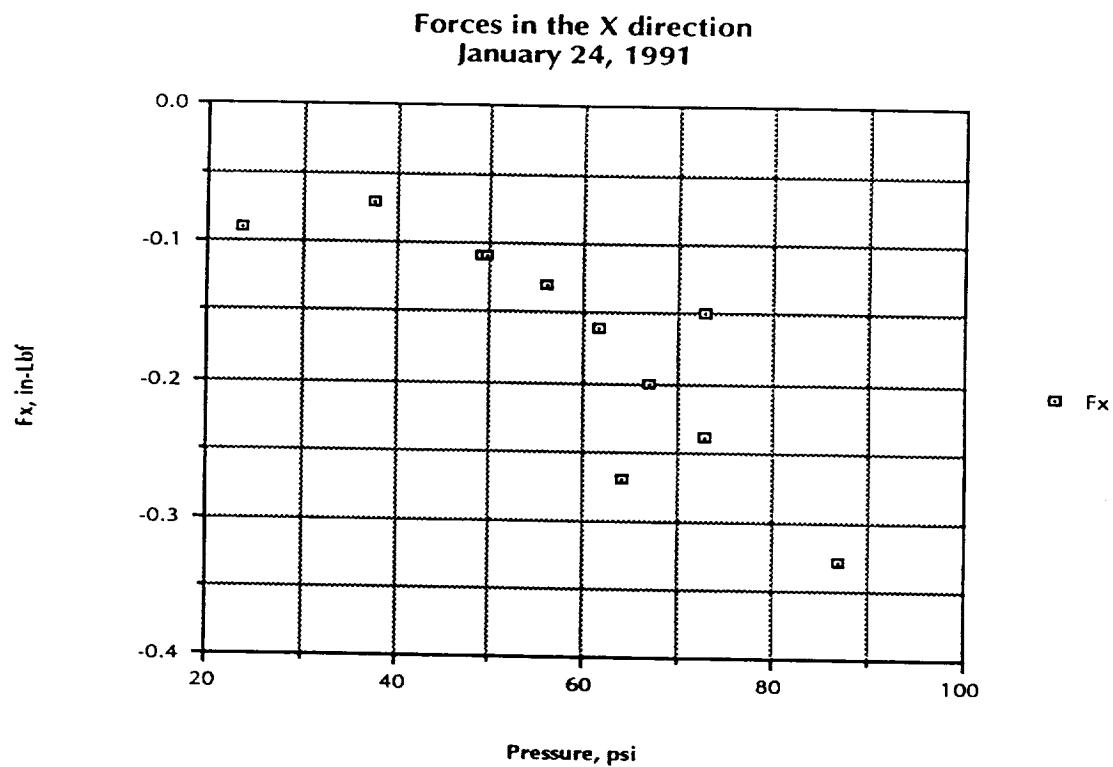
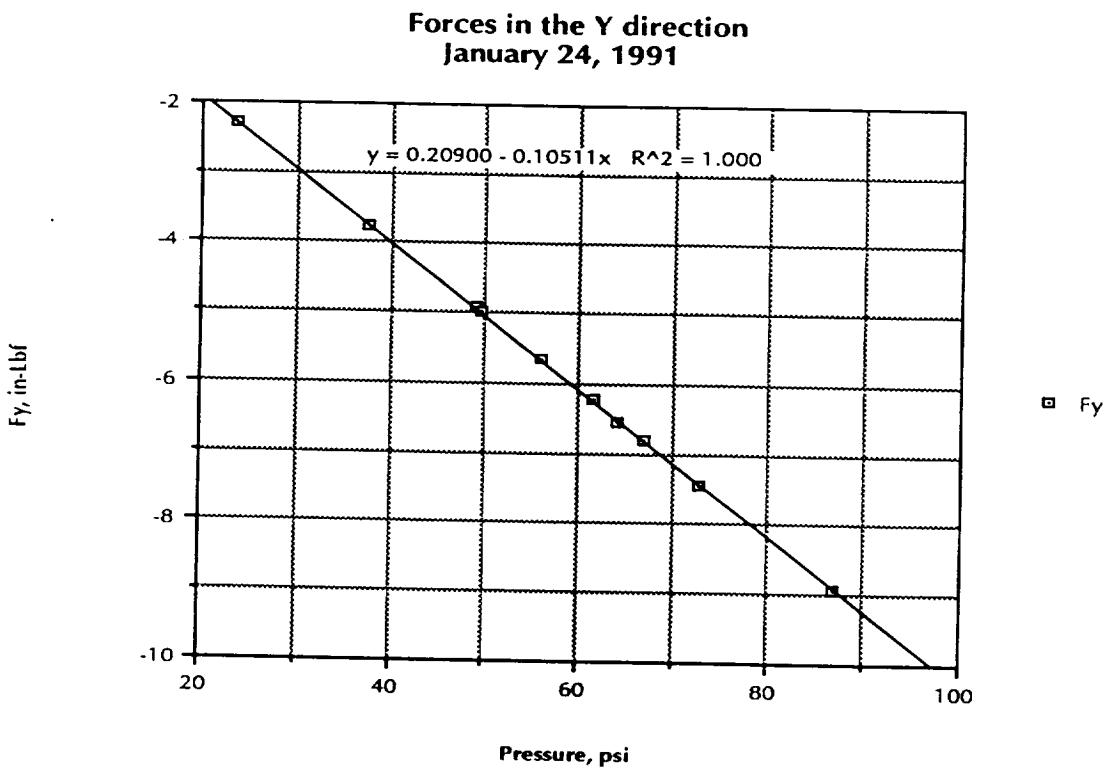
**FIGURE 27**

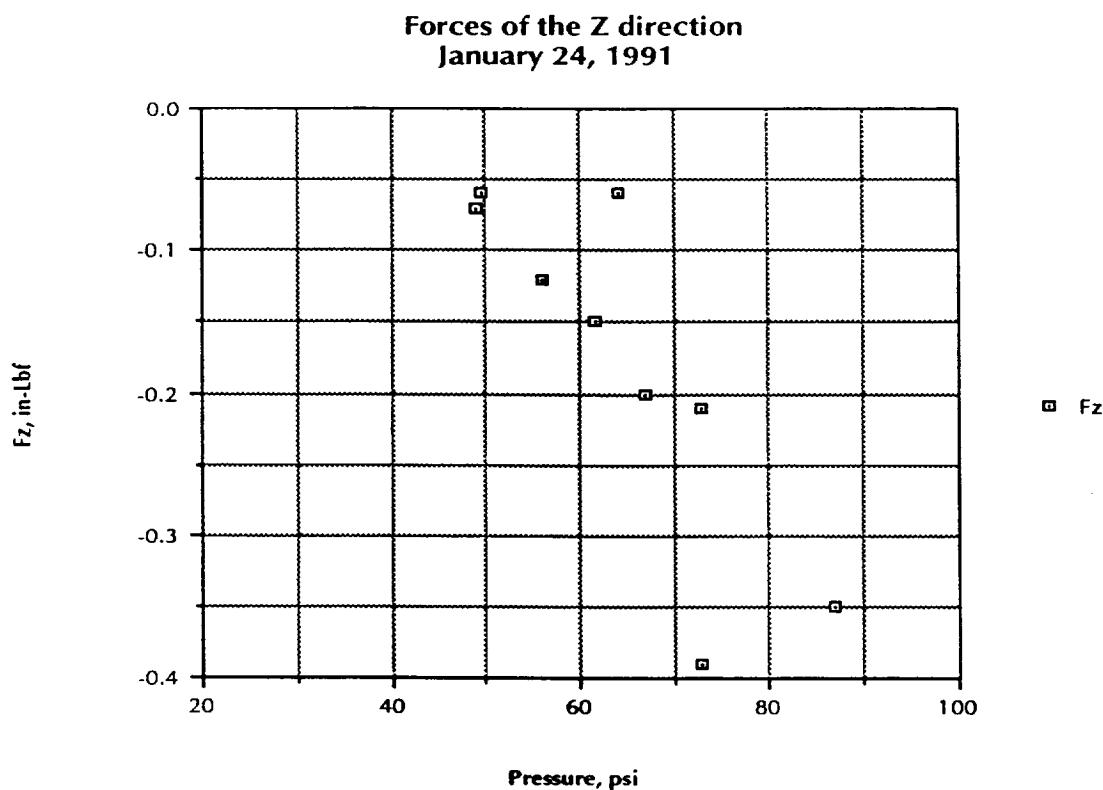
**Load cell 4**  
January 24, 1991



**FIGURE 28**

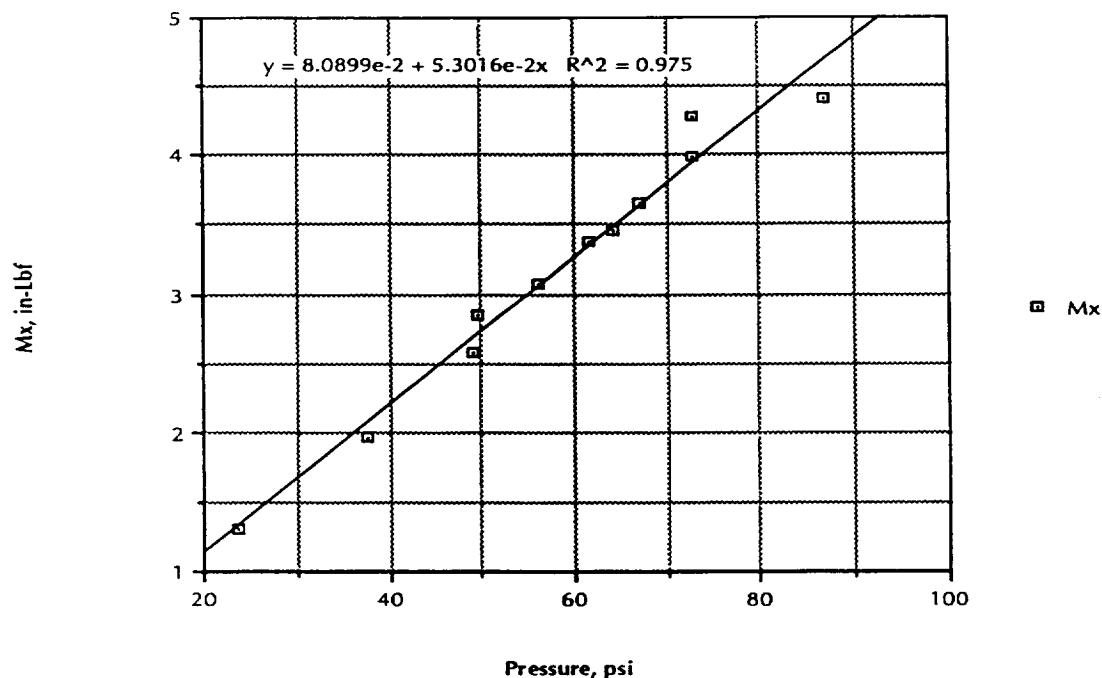
**FIGURE 29****FIGURE 30**

**FIGURE 31****FIGURE 32**



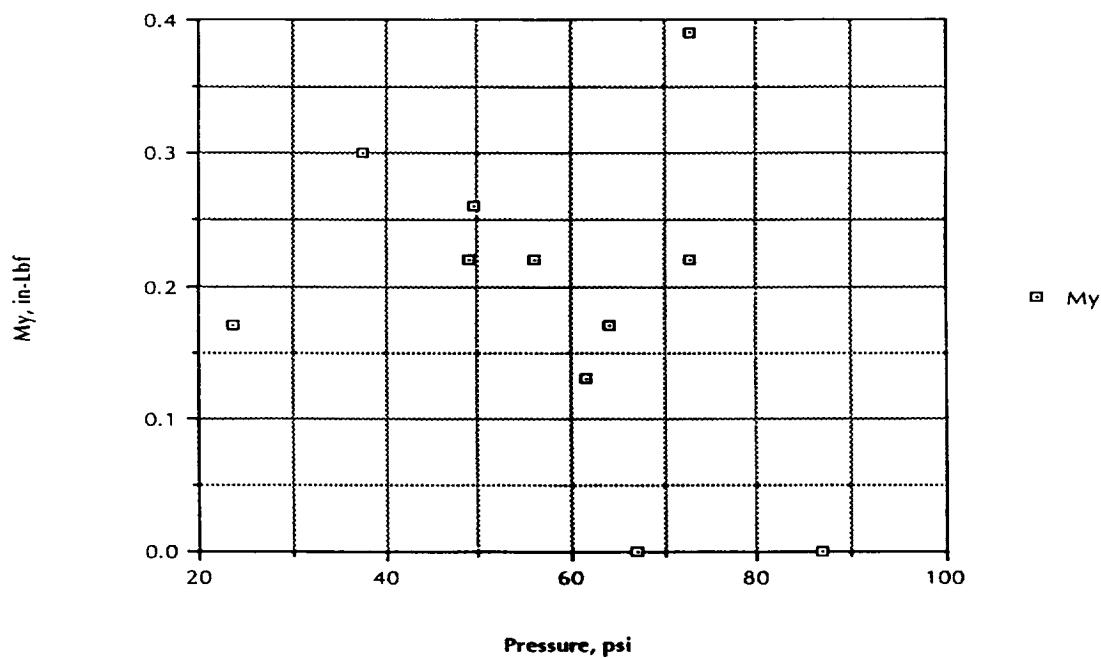
**FIGURE 33**

**Moments in the X direction**  
January 24, 1991



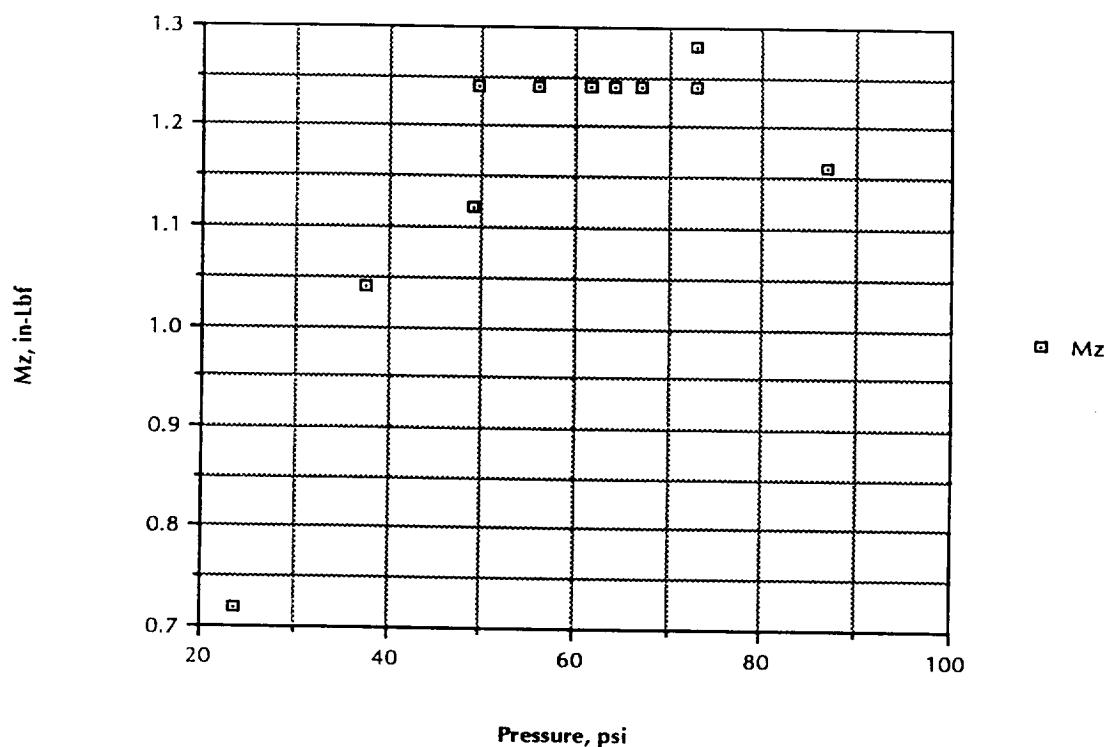
**FIGURE 34**

**Moments in the Y direction**  
January 24, 1991



**FIGURE 35****FIGURE 20**

Moments in the Z direction  
January 24, 1991



**FIGURE 36**

## APPENDIX A

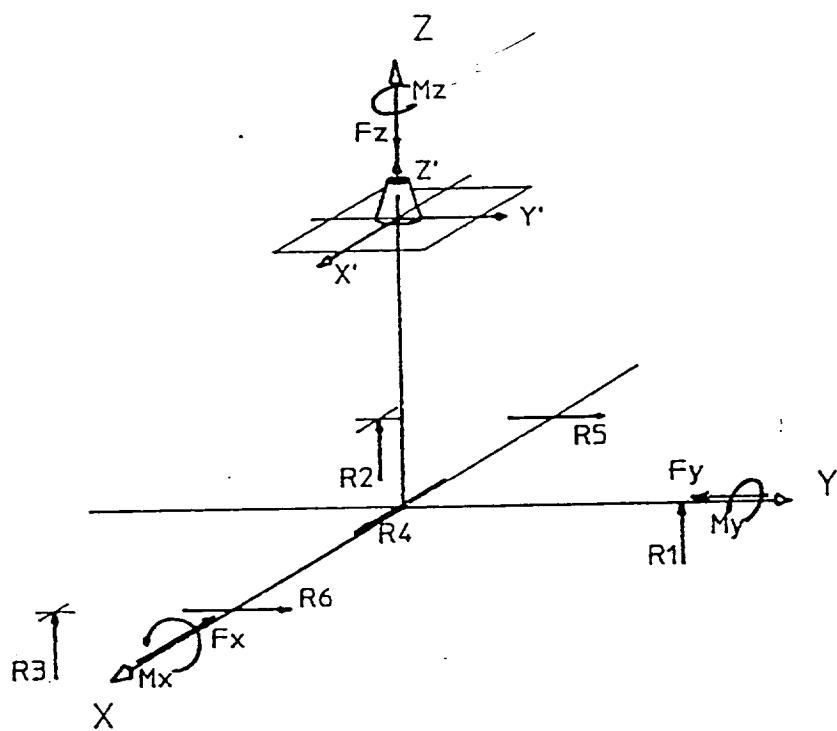
# Reference Coordinate System and Sign Conventions

## Reference Coordinate System and Sign Conventions

By:

Donald Backlund

To obtain useful output data from a thrust stand it is necessary to define a reference coordinate system. For the Cal Poly six-component thrust stand, this coordinate system is defined as shown in figure 1. The  $xy$ -plane shown will be referred to as the "reference plane." The six load cells are designed to all lie in the reference plane.



The forces measured by the load cells are represented by the forces  $R_1$  through  $R_6$  in the figure. The six components measured by the stand,  $F_x$ ,  $F_y$ ,  $F_z$ ,  $M_x$ ,  $M_y$ , and  $M_z$ , are shown. Note that this figure defines the sign convention for these components. Each load cell is located at some coordinates  $(x_i, y_i, z_i)$  relative to the reference coordinate system. The six orthogonal components measured can, in a general form, be calculated as follows:

$$Y_1 = 0$$

53

$$Y_2 = -4.33$$

$\bar{Y}_2 = -2.5$

$$Y_3 = 4.33$$

$\bar{Y}_3 = 2.5$

$$X_4 = 0$$

$\bar{Y}_4 = 0$

$$X_5 = -4$$

$$X_6 = 4.0$$

$$F_x = R_4$$

$$F_y = R_5 + R_6$$

$$F_z = R_1 + R_2 + R_3$$

$$M_x = R_1y_1 + R_2y_2 + R_3y_3 - R_5z_5 - R_6z_6$$

$$M_y = -R_1x_1 - R_2x_2 - R_3x_3 + R_4z_4$$

$$M_z = R_5x_5 + R_6x_6 - R_4y_4$$

The distances  $x_1$ ,  $x_4$ , and  $y_4$  are designed to be zero. As the load cells are designed to all lie in the reference plane, each cell's z-coordinate will be equal to zero. The equations then become:

$$F_x = R_4$$

$$F_y = R_5 + R_6$$

$$F_z = R_1 + R_2 + R_3$$

$$M_x = R_1y_1 + R_2y_2 + R_3y_3$$

$$- M_y = -R_2x_2 - R_3x_3$$

$$M_z = R_5x_5 + R_6x_6$$

Knowledge of these six components can be used to define a single thrust vector,

$$\bar{F} = (-F_x)\bar{i} + (-F_y)\bar{j} + (-F_z)\bar{k}$$

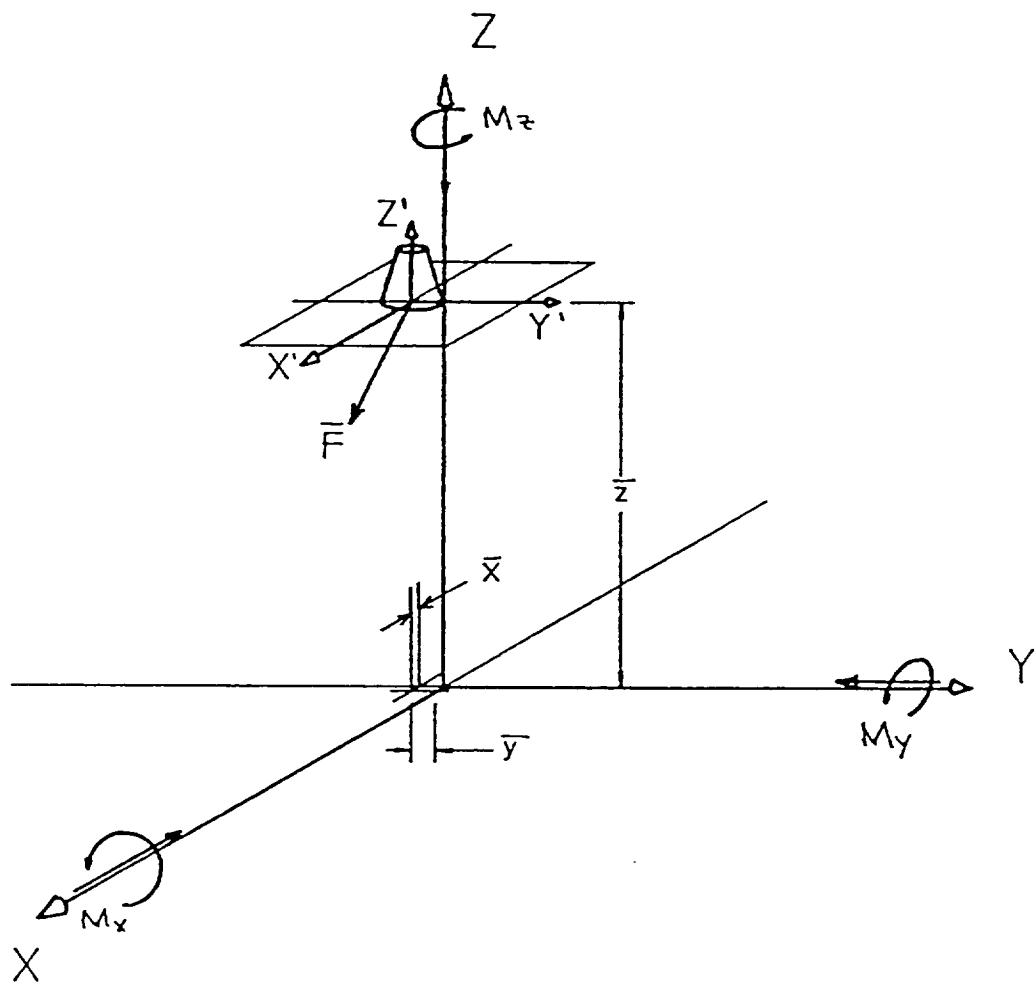
and its location in space relative to the reference plane,  $(\bar{x}, \bar{y}, \bar{z})$ , as shown in figure 2. The coordinates  $(\bar{x}, \bar{y}, \bar{z})$  are found by writing the equilibrium moment equations about each of the three axes of the reference coordinate system.

$$M_x + F_y\bar{z} - F_z\bar{y} = 0$$

$$M_y - F_x\bar{z} + F_z\bar{x} = 0$$

$$M_z + F_x\bar{y} - F_y\bar{x} = 0$$

$$\begin{bmatrix} 0 & +F_z & -F_y \\ -F_z & 0 & +F_x \\ F_y & -F_x & 0 \end{bmatrix} \begin{Bmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{Bmatrix} = \begin{Bmatrix} M_x \\ M_y \\ M_z \end{Bmatrix}$$



## APPENDIX B

### Statistical Data

Calculations for P = 12.8 psi

	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>
1	.74	.72	.68	0	-.68	-.56
2	.74	.66	.61	0	-.72	-.57
3	.79	.80	.72	.01	-.70	-.55
4	.73	.68	.64	-.03	-.70	-.57
5	.76	.76	.72	-.03	-.73	-.57
6	.76	.75	.69	0	-.70	-.57
7	.74	.76	.71	0	-.69	-.56
8	.72	.73	.68	0	-.72	-.56
9	.76	.77	.68	-.02	-.67	-.55
10	.71	.74	.68	-.03	-.70	-.57
M	.745	.737	.681	-.01	-.701	-.563
V	.000539	.00176	.00119	.000244	.000543	.0002063
S	.023214	.0419	.0345	.0156	.0185	.0082

$$M = \sum_{i=1}^n x_i / n$$

$$V = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2$$

$$S = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$$

STATS

84R 39

2/4

Calculations for P = 24.5 psi

Run	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>
1	1.47	1.37	1.34	0	-1.35	-1.10
2	1.49	1.32	1.28	0	-1.35	-1.10
3	1.51	1.31	1.27	-.03	-1.36	-1.12
4	1.48	1.37	1.35	-.03	-1.35	-1.10
5	1.48	1.39	1.34	0	-1.32	-1.07
6	1.45	1.35	1.30	.01	-1.33	-1.03
7	1.50	1.32	1.32	-.02	-1.32	-1.07
8	1.50	1.34	1.31	-.02	-1.32	-1.07
9	1.48	1.33	1.30	-.05	-1.31	-1.06
10	1.47	1.33	1.26	-.03	-1.32	-1.08
M	1.483	1.343	1.307	-.015	-1.331	-1.085
V	.000312	.00069	.000957	.00025	.000277	.000361
S	.01767	.02627	.0309	.0153	.01663	.019005

STATS

SAF

3-9

3/4

Calculations for  $P = 40.7$ 

Run	$R_1$	$R_2$	$R_3$	$R_{21}$	$R_5$	$R_6$
1	2.49	2.16	2.17	-.09	-2.19	-1.83
2	2.46	2.11	2.03	-.04	-2.19	-1.82
3	2.46	2.11	2.03	-.13	-2.21	-1.84
4	2.46	2.11	2.08	0	-2.18	-1.81
5	2.44	2.13	2.09	-.03	-2.19	-1.86
6	2.44	2.10	2.12	-.02	-2.21	-1.82
7	2.47	2.13	2.15	.03	-2.18	-1.82
8	2.45	2.09	2.08	.05	-2.18	-1.81
9	2.42	2.13	2.11	-.06	-2.19	-1.84
10	2.46	2.08	2.07	-.01	-2.20	-1.86

M	2.455	2.115	2.093	-.03	-2.192	-1.831
V	.000361	.00054	.002112	.00289	.00013	.000343
O	.0190	.0232	.04596	.0537	.01135	.01853

STHS

SAF 39

4/4

Calculations for P = 78.7

Run	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>
1	4.72	3.95	3.99	-0.03	-4.50	-3.79
2	4.76	4.03	3.99	-1.23	-4.28	-3.78
3	4.70	4.00	3.97	-1.22	-4.27	-3.76
4	4.73	4.01	3.97	-1.27	-4.28	-3.78
5	4.74	4.07	3.92	-1.31	-4.28	-3.76
6	4.72	3.87	4.05	-1.03	-4.28	-3.76
7	4.77	3.93	4.08	-1.19	-4.28	-3.77
8	4.70	3.90	4.06	-1.17	-4.30	-3.77
9	4.72	3.97	3.97	-1.16	-4.29	-3.79
10	4.70	4.01	3.99	-1.25	-4.27	-3.76
M	4.726	3.974	3.999	-1.19	-4.283	-3.77
V	.000604	.003927	.00243	.00732	.000112	.00015
O	.0246	.06181	.0493	.08556	.0106	.0123

## APPENDIX C

### October 2, 1990 Data

# THIS SIDE STRAIGHT NOZZLE

cup seal - no bellows

2 OCT 90

BACKLUND, FLAKE

\*\*\*\*\* Record 00:39 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A20*Press. 1 Ave	-2.8	psig		
B 1*Read 1	25.91	lbf		
B 2*Read 2	-16.81	lbf		
B 3*Read 3	19.97	lbf		
B 4*Read 4	-0.77	lbf		
B 5*Read 5	0.60	lbf		
B 6*Read 6	0.81	lbf		

\*\*\*\*\* Record 00:39 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.1	psig		
A20*Press. 1 Ave	16.2	psig		
B 1*Read 1	27.86	lbf		
B 2*Read 2	-15.21	lbf		
B 3*Read 3	21.70	lbf		
B 4*Read 4	-0.58	lbf		
B 5*Read 5	-0.35	lbf		
B 6*Read 6	0.12	lbf		

\*\*\*\*\* Record 00:41 - 00-Jan-72

\*\*\*\*\*

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.1	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.1	psig		
B 1*Read 1	25.87	lbf		
B 2*Read 2	-16.99	lbf		
B 3*Read 3	20.32	lbf		
B 4*Read 4	-0.84	lbf		
B 5*Read 5	0.73	lbf		
B 6*Read 6	0.79	lbf		

\*\*\*\*\* Record 00:41 - 00-Jan-72

\*\*\*\*\*

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	23.2	psig		
A 8*Pressure 2	34.6	psig		
A20*Press. 1 Ave	23.4	psig		
A21*Press. 2 Ave	34.8	psig		
B 1*Read 1	28.60	lbf		
B 2*Read 2	-14.58	lbf		
B 3*Read 3	22.90	lbf		
B 4*Read 4	-0.55	lbf		
B 5*Read 5	-0.58	lbf		
B 6*Read 6	-0.22	lbf		

\*\*\*\*\* Record 00:42 - 00-Jan-72

\*\*\*\*\*

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.1	psig		
B 1*Read 1	25.79	lbf		
B 2*Read 2	-17.05	lbf		
B 3*Read 3	20.50	lbf		
B 4*Read 4	-0.88	lbf		
B 5*Read 5	0.70	lbf		
B 6*Read 6	0.62	lbf		

\*\*\*\*\* Record 00:43 - 00-Jan-72

\*\*\*\*\*

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages

A 7*Pressure 1	28.3 psig
A 8*Pressure 2	41.0 psig
A20*Press. 1 Ave	28.5 psig
A21*Press. 2 Ave	41.2 psig
B 1*Read 1	29.08 lbf
B 2*Read 2	-14.16 lbf
B 3*Read 3	23.31 lbf
B 4*Read 4	-0.51 lbf
B 5*Read 5	-0.75 lbf
B 6*Read 6	-0.39 lbf

\*\*\*\*\* Record 00:45 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.1	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.1	psig		
B 1*Read 1	25.88	lbf		
B 2*Read 2	-16.84	lbf		
B 3*Read 3	20.26	lbf		
B 4*Read 4	-0.97	lbf		
B 5*Read 5	0.60	lbf		
B 6*Read 6	0.63	lbf		

\*\*\*\*\* Record 00:46 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	32.6	psig		
A 8*Pressure 2	46.7	psig		
A20*Press. 1 Ave	33.0	psig		
A21*Press. 2 Ave	46.9	psig		
B 1*Read 1	29.65	lbf		
B 2*Read 2	-13.26	lbf		
B 3*Read 3	23.61	lbf		
B 4*Read 4	-0.71	lbf		
B 5*Read 5	-0.69	lbf		
B 6*Read 6	-0.33	lbf		

\*\*\*\*\* Record 00:46 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.67	lbf		
B 2*Read 2	-16.68	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

B 3*Read 3	20.25 lbf
B 4*Read 4	-0.93 lbf
B 5*Read 5	1.06 lbf
B 6*Read 6	0.92 lbf

\*\*\*\*\* Record 00:47 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	42.7	psig		
A 8*Pressure 2	60.4	psig		
A20*Press. 1 Ave	42.9	psig		
A21*Press. 2 Ave	60.6	psig		
B 1*Read 1	30.26	lbf		
B 2*Read 2	-12.02	lbf		
B 3*Read 3	25.15	lbf		
B 4*Read 4	-0.38	lbf		
B 5*Read 5	0.05	lbf		
B 6*Read 6	-0.35	lbf		

\*\*\*\*\* Record 00:47 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.84	lbf		
B 2*Read 2	-17.13	lbf		
B 3*Read 3	20.79	lbf		
B 4*Read 4	-1.28	lbf		
B 5*Read 5	1.00	lbf		
B 6*Read 6	0.92	lbf		

\*\*\*\*\* Record 00:48 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.2	psig		
A 8*Pressure 2	69.4	psig		
A20*Press. 1 Ave	49.6	psig		
A21*Press. 2 Ave	69.8	psig		
B 1*Read 1	31.23	lbf		
B 2*Read 2	-11.82	lbf		
B 3*Read 3	26.39	lbf		
B 4*Read 4	-0.54	lbf		
B 5*Read 5	-0.01	lbf		
B 6*Read 6	-0.23	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

```

***** Record 00:48 - 00-00-74

System identification data          Process parameter list
-----                         -----
*** Monitor ***
# Name      Value   Unit Alarm messages
-----
A 7*Pressure 1           -2.8 psig
A 8*Pressure 2           -1.2 psig
A20*Press. 1 Ave         -2.8 psig
A21*Press. 2 Ave         -1.2 psig
E 1*Read 1              25.74 lbf
B 2*Read 2              -16.94 lbf
B 3*Read 3              20.58 lbf
B 4*Read 4              -1.63 lbf
B 5*Read 5              0.80 lbf
B 6*Read 6              0.51 lbf

```

\*\*\*\*\* Record 00:50 - 00-Jan-72

System identification data Process parameter list

---

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	59.0	psig		
A 8*Pressure 2	82.1	psig		
A20*Press. 1 Ave	59.0	psig		
A21*Press. 2 Ave	82.0	psig		
B 1*Read 1	32.44	lbf		
B 2*Read 2	-10.55	lbf		
B 3*Read 3	27.46	lbf		
B 4*Read 4	-0.37	lbf		
B 5*Read 5	-0.94	lbf		
B 6*Read 6	-1.17	lbf		

\*\*\*\*\* Record 00:50 - 00-Jan-72

System identification data Process parameter list

---

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	26.07	lbf		
B 2*Read 2	-16.93	lbf		
B 3*Read 3	20.30	lbf		
B 4*Read 4	-1.19	lbf		
B 5*Read 5	1.92	lbf		
B 6*Read 6	2.11	lbf		

\*\*\*\*\* Record 00:51 - 00-Jan-72

**ORIGINAL PAGE IS  
OF POOR QUALITY**

**SYSTEM IDENTIFICATION DATA**

PROBLEMS FOR STUDENTS 1156

\*\*\* Monitor \*\*\*

#	Name	Value	Unit	Alarm	messages
---	------	-------	------	-------	----------

A 7*Pressure 1	64.1	psig
A 8*Pressure 2	90.3	psig
A20*Press. 1 Ave	64.2	psig
A21*Press. 2 Ave	90.3	psig
B 1*Read 1	32.77	lbf
B 2*Read 2	-10.09	lbf
B 3*Read 3	28.03	lbf
B 4*Read 4	0.02	lbf
B 5*Read 5	0.39	lbf
B 6*Read 6	-0.02	lbf

— \* —

\*\*\*\*\* Record 00:52 - 00-Jan-72

### System identification data

### Process parameter list

\*\*\* Monitor \*\*\*

#	Name	Value	Unit	Alarm	messages
---	------	-------	------	-------	----------

A 7*Pressure 1	-2.8	psig
A 8*Pressure 2	-1.2	psig
A20*Press. 1 Ave	-2.8	psig
A21*Press. 2 Ave	-1.2	psig
B 1*Read 1	25.82	lbf
B 2*Read 2	-16.34	lbf
B 3*Read 3	20.05	lbf
B 4*Read 4	-2.17	lbf
B 5*Read 5	1.01	lbf
B 6*Read 6	0.73	lbf

\* \* \* \* \*

\*\*\*\*\* Record 00:52 - 00-Jan-72

#### System identification data

### Process parameter list

\*\*\* Monitor \*\*\*

#	Name	Value	Unit	Alarm	messages
---	------	-------	------	-------	----------

A 7*Pressure 1	-2.8	psig
A 8*Pressure 2	-1.2	psig
A20*Press. 1 Ave	-2.8	psig
A21*Press. 2 Ave	-1.2	psig
B 1*Read 1	25.84	lbf
B 2*Read 2	-16.79	lbf
B 3*Read 3	20.41	lbf
B 4*Read 4	-0.92	lbf
B 5*Read 5	0.83	lbf
B 6*Read 6	0.71	lbf

• • • •

\*\*\*\*\* Record 00:53 - 00-Jan-72

#### System identification data

### Process parameter list

\*\*\* Monitor \*\*\*

\*\*\* Monitor \*\*\*

Name	Value	Unit	Alarm	Messages
------	-------	------	-------	----------

**ORIGINAL PAGE IS  
OF POOR QUALITY**

A 7*Pressure 1	23.1 psig
A 8*Pressure 2	23.5 psig
A20*Press. 1 Ave	23.3 psig
A21*Press. 2 Ave	23.6 psig
B 1*Read 1	28.36 lbf
B 2*Read 2	-14.06 lbf
B 3*Read 3	23.05 lbf
B 4*Read 4	-1.11 lbf
B 5*Read 5	-0.41 lbf
B 6*Read 6	-0.66 lbf

\*\*\*\*\* Record 00:54 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.70	lbf		
B 2*Read 2	-16.75	lbf		
B 3*Read 3	20.40	lbf		
B 4*Read 4	-0.86	lbf		
B 5*Read 5	1.19	lbf		
B 6*Read 6	0.90	lbf		

\*\*\*\*\* Record 00:54 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	26.7	psig		
A 8*Pressure 2	37.8	psig		
A20*Press. 1 Ave	26.8	psig		
A21*Press. 2 Ave	38.0	psig		
B 1*Read 1	28.55	lbf		
B 2*Read 2	-13.32	lbf		
B 3*Read 3	23.46	lbf		
B 4*Read 4	-1.04	lbf		
B 5*Read 5	0.06	lbf		
B 6*Read 6	-0.62	lbf		

\*\*\*\*\* Record 00:55 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.70	lbf		
B 2*Read 2	-17.05	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

B 3*Read 3	20.70 lbf
B 4*Read 4	-0.87 lbf
B 5*Read 5	1.39 lbf
B 6*Read 6	1.09 lbf

\*\*\*\*\* Record 00:56 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	38.0	psig		
A 8*Pressure 2	52.7	psig		
A20*Press. 1 Ave	38.3	psig		
A21*Press. 2 Ave	53.0	psig		
B 1*Read 1	29.54	lbf		
B 2*Read 2	-12.74	lbf		
B 3*Read 3	25.20	lbf		
B 4*Read 4	-0.94	lbf		
B 5*Read 5	0.05	lbf		
B 6*Read 6	-0.76	lbf		

\*\*\*\*\* Record 00:56 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.74	lbf		
B 2*Read 2	-16.70	lbf		
B 3*Read 3	20.34	lbf		
B 4*Read 4	-0.88	lbf		
B 5*Read 5	1.28	lbf		
B 6*Read 6	1.04	lbf		

\*\*\*\*\* Record 00:57 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	30.5	psig		
A 8*Pressure 2	42.9	psig		
A20*Press. 1 Ave	30.8	psig		
A21*Press. 2 Ave	43.1	psig		
B 1*Read 1	28.89	lbf		
B 2*Read 2	-12.98	lbf		
B 3*Read 3	23.86	lbf		
B 4*Read 4	-1.02	lbf		
B 5*Read 5	0.07	lbf		
B 6*Read 6	-0.56	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

*** Monitor ***		Value	Unit	Alarm	messages
#	Name				
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.2	psig		
A20	*Press. 1 Ave	-2.8	psig		
A21	*Press. 2 Ave	-1.2	psig		
B	1*Read 1	25.75	lbf		
B	2*Read 2	-16.89	lbf		
B	3*Read 3	20.47	lbf		
B	4*Read 4	-0.87	lbf		
B	5*Read 5	1.23	lbf		
B	6*Read 6	1.00	lbf		

\*\*\*\*\* Record 00:58 - 00-Jan-72

System identification data      Process parameter list

```

*** Monitor ***
# Name          Value   Unit Alarm  messages
-----
A 7*Pressure 1      39.2 psig
A 8*Pressure 2      54.4 psig
A20*Press. 1 Ave    39.4 psig
A21*Press. 2 Ave    54.6 psig
B 1*Read 1          29.70 lbf
B 2*Read 2          -12.51 lbf
B 3*Read 3          25.21 lbf
B 4*Read 4          -0.95 lbf
B 5*Read 5          -0.26 lbf
B 6*Read 6          -1.07 lbf

```

\*\*\*\*\* Record 00:59 - 00-Jan-72

System identification data      Process parameter list

*** Monitor ***		Value	Unit	Alarm	messages
#	Name				
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.2	psig		
A20	*Press. 1 Ave	-2.8	psig		
A21	*Press. 2 Ave	-1.2	psig		
B	1*Read 1	26.03	lbf		
B	2*Read 2	-16.97	lbf		
B	3*Read 3	20.20	lbf		
B	4*Read 4	-0.92	lbf		
B	5*Read 5	0.20	lbf		
B	6*Read 6	0.44	lbf		

\*\*\*\*\* Record 01:00 - 00-Jan-72

System identification data      Process parameter list

\*\*\* Monitor \*\*\*

ORIGINAL PAGE IS  
OF POOR QUALITY

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	48.4	psig		
A 8*Pressure 2	66.9	psig		
A20*Press. 1 Ave	48.3	psig		
A21*Press. 2 Ave	55.9	psig		
B 1*Read 1	30.73	lbf		
B 2*Read 2	-11.48	lbf		
B 3*Read 3	26.40	lbf		
B 4*Read 4	-1.11	lbf		
B 5*Read 5	-0.79	lbf		
B 6*Read 6	-1.62	lbf		

\*\*\*\*\* Record 01:01 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.6	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.72	lbf		
B 2*Read 2	-17.22	lbf		
B 3*Read 3	20.68	lbf		
B 4*Read 4	-0.90	lbf		
B 5*Read 5	1.05	lbf		
B 6*Read 6	0.91	lbf		

\*\*\*\*\* Record 01:01 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	54.1	psig		
A 8*Pressure 2	75.1	psig		
A20*Press. 1 Ave	54.3	psig		
A21*Press. 2 Ave	75.0	psig		
B 1*Read 1	31.38	lbf		
B 2*Read 2	-11.19	lbf		
B 3*Read 3	27.84	lbf		
B 4*Read 4	-0.91	lbf		
B 5*Read 5	-0.77	lbf		
B 6*Read 6	-1.80	lbf		

\*\*\*\*\* Record 01:02 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		

ORIGINAL PAGE IS  
OF POOR QUALITY

B 1*Read 1	25.64 lbf
B 2*Read 2	-16.70 lbf
B 3*Read 3	20.44 lbf
B 4*Read 4	-0.89 lbf
B 5*Read 5	1.38 lbf
B 6*Read 6	0.99 lbf

\*\*\*\*\* Record 01:03 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.4	psig		
A 8*Pressure 2	86.4	psig		
A20*Press. 1 Ave	61.8	psig		
A21*Press. 2 Ave	86.8	psig		
B 1*Read 1	32.23	lbf		
B 2*Read 2	-9.58	lbf		
B 3*Read 3	28.95	lbf		
B 4*Read 4	-0.81	lbf		
B 5*Read 5	-0.37	lbf		
B 6*Read 6	-2.05	lbf		

\*\*\*\*\* Record 01:03 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.63	lbf		
B 2*Read 2	-16.60	lbf		
B 3*Read 3	20.29	lbf		
B 4*Read 4	-0.85	lbf		
B 5*Read 5	1.38	lbf		
B 6*Read 6	1.00	lbf		

\*\*\*\*\* Record 01:04 - 00-Jan-72

\*\*\*\*\*

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	14.5	psig		
A 8*Pressure 2	22.8	psig		
A20*Press. 1 Ave	14.5	psig		
A21*Press. 2 Ave	22.8	psig		
B 1*Read 1	32.23	lbf		
B 2*Read 2	-9.58	lbf		
B 3*Read 3	28.95	lbf		
B 4*Read 4	-0.81	lbf		
B 5*Read 5	-0.37	lbf		
B 6*Read 6	-2.05	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* Record 01:07 - 09-Jan-72

## Process parameter list

	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A20*Press. 1 Ave	-2.8	psig		
A21*Press. 2 Ave	-1.2	psig		
B 1*Read 1	25.75	lbf		
B 2*Read 2	-16.75	lbf		
B 3*Read 3	20.3	lbf		
B 4*Read 4	-0.5	lbf		
B 5*Read 5	-0.01	lbf		
B 6*Read 6	-0.53	lbf		

## messages

A 7*Pressure 1	-1.7	psig
A 8*Pressure 2	31.8	psig
A20*Press. 1 Ave	21.8	psig
A21*Press. 2 Ave	31.9	psig
B 1*Read 1	28.10	lbf
B 2*Read 2	-14.04	lbf
B 3*Read 3	23.02	lbf
B 4*Read 4	-1.04	lbf
B 5*Read 5	-0.01	lbf
B 6*Read 6	-0.53	lbf

\*\*\*\*\* Record 01:07 - 09-Jan-72

## System identification data

## Process parameter list

*** Monitor ***	# Name	Value	Unit	Alarm	messages
A 7*Pressure 1		-2.8	psig		
A 8*Pressure 2		-1.2	psig		
A20*Press. 1 Ave		-2.8	psig		
A21*Press. 2 Ave		-1.2	psig		
B 1*Read 1		25.75	lbf		
B 2*Read 2		-16.75	lbf		
B 3*Read 3		20.3	lbf		
B 4*Read 4		-0.5	lbf		
B 5*Read 5		-0.01	lbf		
B 6*Read 6		-0.53	lbf		

\*\*\*\*\*

## System identification data

ORIGINAL PAGE IS  
OF POOR QUALITY

ss. 1 Ave	-2.8 psig
A21*Press. 2 Ave	-1.2 psig
B 1*Read 1	25.98 lbf
B 2*Read 2	-16.97 lbf
B 3*Read 3	20.30 lbf
B 4*Read 4	-0.92 lbf
B 5*Read 5	0.46 lbf
B 6*Read 6	0.59 lbf

\*\*\*\*\* Record 01:11 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	37.5	psig		
A 8*Pressure 2	51.9	psig		
A20*Press. 1 Ave	37.9	psig		
A21*Press. 2 Ave	52.3	psig		
B 1*Read 1	29.98	lbf		
B 2*Read 2	-12.88	lbf		
B 3*Read 3	24.77	lbf		
B 4*Read 4	-0.94	lbf		
B 5*Read 5	-1.50	lbf		
B 6*Read 6	-1.63	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

## APPENDIX D

### December 14, 1990 Data

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:29 - 00-Jan-72

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.7	psig		
A16*Press2	-0.9	psig		
A17*R1	8.60	lbf		
A18*R2	-12.43	lbf		
A19*R3	23.36	lbf		
A20*R4	-2.90	lbf		
A21*R5	3.72	lbf		
A22*R6	0.91	lbf		

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:30 - 00-Jan-72

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	15.6	psig		
A 8*Pressure 2	11.9	psig		
A15*Press1	15.6	psig		
A16*Press2	12.0	psig		
A17*R1	10.09	lbf		
A18*R2	-11.25	lbf		
A19*R3	25.05	lbf		
A20*R4	-2.85	lbf		
A21*R5	4.51	lbf		
A22*R6	2.25	lbf		

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:32 - 00-Jan-72

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.81	lbf		
A18*R2	-12.58	lbf		
A19*R3	23.24	lbf		
A20*R4	-2.88	lbf		
A21*R5	3.74	lbf		
A22*R6	0.97	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:33 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	18.0	psig		
A 8*Pressure 2	13.8	psig		
A15*Press1	17.9	psig		
A16*Press2	13.8	psig		
A17*R1	10.37	lbf		
A18*R2	-11.10	lbf		
A19*R3	25.22	lbf		
A20*R4	-2.86	lbf		
A21*R5	4.67	lbf		
A22*R6	2.41	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:34 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.79	lbf		
A18*R2	-12.60	lbf		
A19*R3	23.23	lbf		
A20*R4	-2.90	lbf		
A21*R5	3.74	lbf		
A22*R6	0.98	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:36 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	21.5	psig		
A 8*Pressure 2	16.7	psig		
A15*Press1	21.6	psig		
A16*Press2	16.8	psig		
A17*R1	10.94	lbf		
A18*R2	-11.12	lbf		
A19*R3	25.32	lbf		
A20*R4	-2.79	lbf		
A21*R5	4.73	lbf		
A22*R6	2.82	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:36 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.79	lbf		
A18*R2	-12.70	lbf		
A19*R3	23.18	lbf		
A20*R4	-2.87	lbf		
A21*R5	3.69	lbf		
A22*R6	1.03	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:38 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	27.9	psig		
A 8*Pressure 2	22.0	psig		
A15*Press1	28.0	psig		
A16*Press2	22.1	psig		
A17*R1	11.58	lbf		
A18*R2	-10.67	lbf		
A19*R3	25.94	lbf		
A20*R4	-2.87	lbf		
A21*R5	4.93	lbf		
A22*R6	3.31	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:38 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.76	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.22	lbf		
A20*R4	-2.89	lbf		
A21*R5	3.70	lbf		
A22*R6	1.03	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:39 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.4	psig		
A 8*Pressure 2	24.1	psig		
A15*Press1	30.3	psig		
A16*Press2	23.9	psig		
A17*R1	11.74	lbf		
A18*R2	-10.51	lbf		
A19*R3	26.14	lbf		
A20*R4	-2.83	lbf		
A21*R5	4.99	lbf		
A22*R6	3.49	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:39 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.77	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.18	lbf		
A20*R4	-2.65	lbf		
A21*R5	3.64	lbf		
A22*R6	1.05	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:40 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.8	psig		
A 8*Pressure 2	23.6	psig		
A15*Press1	29.9	psig		
A16*Press2	23.7	psig		
A17*R1	11.75	lbf		
A18*R2	-10.57	lbf		
A19*R3	26.14	lbf		
A20*R4	-2.94	lbf		
A21*R5	4.95	lbf		
A22*R6	3.47	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:41 - 00-Jan-72

System identification data

Process parameter list

*M✓*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.79	lbf		
A18*R2	-12.75	lbf		
A19*R3	23.21	lbf		
A20*R4	-2.93	lbf		
A21*R5	3.63	lbf		
A22*R6	1.07	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:42 - 00-Jan-72

System identification data

Process parameter list

*S✓*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	33.9	psig		
A 8*Pressure 2	26.9	psig		
A15*Press1	34.0	psig		
A16*Press2	27.0	psig		
A17*R1	12.16	lbf		
A18*R2	-10.30	lbf		
A19*R3	26.51	lbf		
A20*R4	-2.92	lbf		
A21*R5	5.08	lbf		
A22*R6	3.80	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:42 - 00-Jan-72

System identification data

Process parameter list

*S✓*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.6	psig		
A16*Press2	-0.9	psig		
A17*R1	8.84	lbf		
A18*R2	-12.71	lbf		
A19*R3	23.16	lbf		
A20*R4	-2.78	lbf		
A21*R5	3.60	lbf		
A22*R6	1.11	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:43 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	35.9	psig		
A 8*Pressure 2	28.6	psig		
A15*Press1	36.1	psig		
A16*Press2	28.8	psig		
A17*R1	12.26	lbf		
A18*R2	-10.09	lbf		
A19*R3	26.75	lbf		
A20*R4	-2.95	lbf		
A21*R5	5.25	lbf		
A22*R6	3.84	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:44 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.7	psig		
A16*Press2	-0.9	psig		
A17*R1	8.80	lbf		
A18*R2	-12.74	lbf		
A19*R3	23.17	lbf		
A20*R4	-2.86	lbf		
A21*R5	3.61	lbf		
A22*R6	1.10	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 00:45 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	38.3	psig		
A 8*Pressure 2	30.6	psig		
A15*Press1	38.4	psig		
A16*Press2	30.7	psig		
A17*R1	12.55	lbf		
A18*R2	-10.00	lbf		
A19*R3	26.87	lbf		
A20*R4	-2.84	lbf		
A21*R5	5.24	lbf		
A22*R6	4.11	lbf		

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:45 - 00-Jan-72

## Process parameter list

10 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.7	psig		
A16*Press2	-0.9	psig		
A17*R1	8.78	lbf		
A18*R2	-12.71	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.86	lbf		
A21*R5	3.63	lbf		
A22*R6	1.08	lbf		

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:46 - 00-Jan-72

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	38.6	psig		
A 8*Pressure 2	30.8	psig		
A15*Press1	38.5	psig		
A16*Press2	30.8	psig		
A17*R1	12.28	lbf		
A18*R2	-9.85	lbf		
A19*R3	27.01	lbf		
A20*R4	-2.86	lbf		
A21*R5	5.33	lbf		
A22*R6	4.06	lbf		

\*\*\*\*\* 12/14/90

## System identification data

\*\*\*\*\* Record 00:47 - 00-Jan-72

## Process parameter list

11 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-0.9	psig		
A15*Press1	-2.7	psig		
A16*Press2	-0.9	psig		
A17*R1	8.75	lbf		
A18*R2	-12.74	lbf		
A19*R3	23.18	lbf		
A20*R4	-2.83	lbf		
A21*R5	3.65	lbf		
A22*R6	1.09	lbf		

\*\*\*\*\* 12/14/90

System identification data

	Value	Unit	Alarm	messages
A 7*Pressure 1	48.5	psig		
A 8*Pressure 2	39.0	psig		
A 15*Press1	48.5	psig		
A 16*Press2	39.0	psig		
A17*R1	13.32	lbf		
A18*R2	-9.19	lbf		
A19*R3	27.96	lbf		
A20*R4	-2.77	lbf		
A21*R5	5.61	lbf		
A22*R6	4.79	lbf		

\*\*\*\*\* 12/14/90

System identification data

	Value	Unit	Alarm	messages
A 7*Pressure 1	48.5	psig		
A 8*Pressure 2	39.0	psig		
A 15*Press1	48.5	psig		
A 16*Press2	39.0	psig		
A17*R1	13.32	lbf		
A18*R2	-9.19	lbf		
A19*R3	27.96	lbf		
A20*R4	-2.77	lbf		
A21*R5	5.61	lbf		
A22*R6	4.79	lbf		

\*\*\*\*\* Record 00:50 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	48.5	psig		
A 8*Pressure 2	39.0	psig		
A15*Press1	48.5	psig		
A16*Press2	39.0	psig		
A17*R1	13.32	lbf		
A18*R2	-9.19	lbf		
A19*R3	27.96	lbf		
A20*R4	-2.77	lbf		
A21*R5	5.61	lbf		
A22*R6	4.79	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 12/14/90

卷之三十一

#### System identification data

### 13. 壓克錶器 Character meter

\*\*\* MGK.

#	Name	Value	Unit	Description
	atmosphere	1	101325	Atmospheric pressure
A 8*Pressure	8	101325	Pa	Atmospheric pressure
A15*Pressure	15	101325	Pa	Atmospheric pressure
alpha	0.002	0.002	1	Alpha parameter
beta	0.001	0.001	1	Beta parameter
gamma	1.4	1.4	1	Gamma parameter
g	9.81	9.81	1	Gravitational acceleration
mu	0.001	0.001	1	Mu parameter
rho	1000	1000	kg/m^3	Density
sigma	0.001	0.001	1	Sigma parameter
tau	0.001	0.001	1	Tau parameter
theta	0.001	0.001	1	Theta parameter

卷之三

— 1 —

卷之三

```

    :sig
    psig
  8.84 lbf
-12.58 lbf
23.19 lbf
-2.87 lbf
  3.60 lbf
  1.00 lbf

```

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:01 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	50.0	psig		
A 8*Pressure 2	40.2	psig		
A15*Press1	50.3	psig		
A16*Press2	40.3	psig		
A17*R1	13.50	lbf		
A18*R2	-8.90	lbf		
A19*R3	28.18	lbf		
A20*R4	-2.83	lbf		
A21*R5	5.64	lbf		
A22*R6	4.79	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:02 - 00-Jan-72

## System identification data

## Process parameter list

*ASV*

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.78	lbf		
A18*R2	-12.61	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.86	lbf		
A21*R5	3.61	lbf		
A22*R6	0.99	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	54.4	psig		
A 8*Pressure 2	43.7	psig		
A15*Press1	54.4	psig		
A16*Press2	43.7	psig		
A17*R1	13.65	lbf		
A18*R2	-8.49	lbf		
A19*R3	28.68	lbf		
A20*R4	-2.84	lbf		
A21*R5	5.79	lbf		
A22*R6	4.98	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.78	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.17	lbf		
A20*R4	-2.84	lbf		
A21*R5	3.59	lbf		
A22*R6	1.03	lbf		

16 ✓

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:04 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.3	psig		
A 8*Pressure 2	49.3	psig		
A15*Press1	61.6	psig		
A16*Press2	49.6	psig		
A17*R1	14.42	lbf		
A18*R2	-8.08	lbf		
A19*R3	29.31	lbf		
A20*R4	-2.81	lbf		
A21*R5	6.13	lbf		
A22*R6	5.54	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:05 - 00-Jan-72

## System identification data

## Process parameter list

17 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.78	lbf		
A18*R2	-12.68	lbf		
A19*R3	23.16	lbf		
A20*R4	-2.86	lbf		
A21*R5	3.58	lbf		
A22*R6	1.02	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:06 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.4	psig		
A 8*Pressure 2	50.2	psig		
A15*Press1	62.7	psig		
A16*Press2	50.6	psig		
A17*R1	14.41	lbf		
A18*R2	-7.86	lbf		
A19*R3	29.46	lbf		
A20*R4	-2.85	lbf		
A21*R5	6.13	lbf		
A22*R6	5.54	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:06 - 00-Jan-72

## System identification data

## Process parameter list

18 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.81	lbf		
A18*R2	-12.72	lbf		
A19*R3	23.22	lbf		
A20*R4	-2.88	lbf		
A21*R5	3.57	lbf		
A22*R6	1.04	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:07 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	69.1	psig		
A 8*Pressure 2	55.5	psig		
A15*Press1	69.1	psig		
A16*Press2	55.6	psig		
A17*R1	15.07	lbf		
A18*R2	-7.39	lbf		
A19*R3	30.08	lbf		
A20*R4	-2.80	lbf		
A21*R5	6.31	lbf		
A22*R6	5.99	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:08 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.71	lbf		
A18*R2	-12.72	lbf		
A19*R3	23.22	lbf		
A20*R4	-2.87	lbf		
A21*R5	3.62	lbf		
A22*R6	1.01	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:09 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	75.6	psig		
A 8*Pressure 2	60.8	psig		
A15*Press1	75.6	psig		
A16*Press2	60.8	psig		
A17*R1	15.96	lbf		
A18*R2	-7.02	lbf		
A19*R3	30.55	lbf		
A20*R4	-2.80	lbf		
A21*R5	6.59	lbf		
A22*R6	6.37	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:09 - 00-Jan-72

## System identification data

## Process parameter list

201

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.74	lbf		
A18*R2	-12.68	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.80	lbf		
A21*R5	3.56	lbf		
A22*R6	1.00	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:10 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	77.5	psig		
A 8*Pressure 2	62.2	psig		
A15*Press1	77.5	psig		
A16*Press2	62.2	psig		
A17*R1	15.82	lbf		
A18*R2	-6.66	lbf		
A19*R3	30.97	lbf		
A20*R4	-2.80	lbf		
A21*R5	6.67	lbf		
A22*R6	6.39	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:11 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.82	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.15	lbf		
A20*R4	-2.82	lbf		
A21*R5	3.46	lbf		
A22*R6	0.95	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:12 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	81.5	psig		
A 8*Pressure 2	65.2	psig		
A15*Press1	81.7	psig		
A16*Press2	65.6	psig		
A17*R1	16.46	lbf		
A18*R2	-6.37	lbf		
A19*R3	31.27	lbf		
A20*R4	-2.72	lbf		
A21*R5	6.59	lbf		
A22*R6	6.67	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:52 - 00-Jan-72

## System identification data

## Process parameter list

Shtg A 12/14/90

JW

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	9.03	lbf		
A18*R2	-13.02	lbf		
A19*R3	23.28	lbf		
A20*R4	-2.56	lbf		
A21*R5	3.38	lbf		
A22*R6	0.93	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:52 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	103.7	psig		
A 8*Pressure 2	82.5	psig		
A15*Press1	104.5	psig		
A16*Press2	83.3	psig		
A17*R1	19.00	lbf		
A18*R2	-4.63	lbf		
A19*R3	33.20	lbf		
A20*R4	-2.47	lbf		
A21*R5	7.20	lbf		
A22*R6	7.63	lbf		

*15° offset*

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:19 - 00-Jan-72

## System identification data

## Process parameter list

*1* *↓*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.85	lbf		
A18*R2	-12.60	lbf		
A19*R3	23.26	lbf		
A20*R4	-2.80	lbf		
A21*R5	3.51	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:21 - 00-Jan-72

## System identification data

## Process parameter list

*1*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	11.7	psig		
A 8*Pressure 2	8.7	psig		
A15*Press1	11.7	psig		
A16*Press2	8.7	psig		
A17*R1	11.31	lbf		
A18*R2	-12.39	lbf		
A19*R3	24.06	lbf		
A20*R4	-2.76	lbf		
A21*R5	3.90	lbf		
A22*R6	2.08	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:21 - 00-Jan-72

## System identification data

## Process parameter list

*2* *↓*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.83	lbf		
A18*R2	-12.64	lbf		
A19*R3	23.33	lbf		
A20*R4	-2.87	lbf		
A21*R5	3.51	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:22 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	17.1	psig		
A 8*Pressure 2	12.9	psig		
A15*Press1	16.9	psig		
A16*Press2	12.7	psig		
A17*R1	11.86	lbf		
A18*R2	-12.13	lbf		
A19*R3	24.48	lbf		
A20*R4	-2.77	lbf		
A21*R5	4.04	lbf		
A22*R6	2.42	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:23 - 00-Jan-72

## System identification data

## Process parameter list

34

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.0	psig		
A17*R1	8.82	lbf		
A18*R2	-12.62	lbf		
A19*R3	23.34	lbf		
A20*R4	-2.85	lbf		
A21*R5	3.51	lbf		
A22*R6	0.92	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	28.7	psig		
A 8*Pressure 2	22.3	psig		
A15*Press1	29.3	psig		
A16*Press2	22.7	psig		
A17*R1	14.01	lbf		
A18*R2	-11.81	lbf		
A19*R3	25.12	lbf		
A20*R4	-2.73	lbf		
A21*R5	4.38	lbf		
A22*R6	3.38	lbf		

C-2

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.0	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.75	lbf		
A18*R2	-12.57	lbf		
A19*R3	23.32	lbf		
A20*R4	-2.77	lbf		
A21*R5	3.57	lbf		
A22*R6	0.79	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:25 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	32.4	psig		
A 8*Pressure 2	25.2	psig		
A15*Press1	31.6	psig		
A16*Press2	24.7	psig		
A17*R1	14.51	lbf		
A18*R2	-11.84	lbf		
A19*R3	25.21	lbf		
A20*R4	-2.78	lbf		
A21*R5	4.39	lbf		
A22*R6	3.60	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:25 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.77	lbf		
A18*R2	-12.61	lbf		
A19*R3	23.27	lbf		
A20*R4	-2.80	lbf		
A21*R5	3.52	lbf		
A22*R6	0.82	lbf		

5↓

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:27 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	38.5	psig		
A 8*Pressure 2	30.3	psig		
A15*Press1	38.1	psig		
A16*Press2	30.0	psig		
A17*R1	15.73	lbf		
A18*R2	-11.73	lbf		
A19*R3	25.51	lbf		
A20*R4	-2.75	lbf		
A21*R5	4.72	lbf		
A22*R6	4.12	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:27 - 00-Jan-72

## System identification data

## Process parameter list

6 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.75	lbf		
A18*R2	-12.60	lbf		
A19*R3	23.31	lbf		
A20*R4	-2.78	lbf		
A21*R5	3.51	lbf		
A22*R6	0.81	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:28 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	39.2	psig		
A 8*Pressure 2	30.7	psig		
A15*Press1	39.1	psig		
A16*Press2	30.8	psig		
A17*R1	15.76	lbf		
A18*R2	-11.67	lbf		
A19*R3	25.57	lbf		
A20*R4	-2.64	lbf		
A21*R5	4.58	lbf		
A22*R6	4.23	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:28 - 00-Jan-72

System identification data

Process parameter list

7 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.80	lbf		
A18*R2	-12.65	lbf		
A19*R3	23.27	lbf		
A20*R4	-2.77	lbf		
A21*R5	3.48	lbf		
A22*R6	0.84	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:29 - 00-Jan-72

System identification data

Process parameter list

-----

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	43.4	psig		
A 8*Pressure 2	34.2	psig		
A15*Press1	43.4	psig		
A16*Press2	34.3	psig		
A17*R1	16.95	lbf		
A18*R2	-11.74	lbf		
A19*R3	25.57	lbf		
A20*R4	-2.63	lbf		
A21*R5	4.75	lbf		
A22*R6	4.67	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:29 - 00-Jan-72

System identification data

Process parameter list

8 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.78	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.27	lbf		
A20*R4	-2.80	lbf		
A21*R5	3.48	lbf		
A22*R6	0.84	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:31 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	44.7	psig		
A 8*Pressure 2	35.3	psig		
A15*Press1	45.0	psig		
A16*Press2	35.6	psig		
A17*R1	17.30	lbf		
A18*R2	-11.76	lbf		
A19*R3	25.69	lbf		
A20*R4	-2.72	lbf		
A21*R5	4.78	lbf		
A22*R6	4.81	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:31 - 00-Jan-72

## System identification data

## Process parameter list

9  
↓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.76	lbf		
A18*R2	-12.66	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.70	lbf		
A21*R5	0.49	lbf		
A22*R6	0.85	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:33 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	47.1	psig		
A 8*Pressure 2	37.4	psig		
A15*Press1	47.4	psig		
A16*Press2	37.6	psig		
A17*R1	17.52	lbf		
A18*R2	-11.64	lbf		
A19*R3	25.89	lbf		
A20*R4	-2.64	lbf		
A21*R5	4.88	lbf		
A22*R6	5.00	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:33 - 00-Jan-72

## System identification data

## Process parameter list

10Y

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.76	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.25	lbf		
A20*R4	-2.82	lbf		
A21*R5	3.49	lbf		
A22*R6	0.81	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:34 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	53.5	psig		
A 8*Pressure 2	42.5	psig		
A15*Press1	53.7	psig		
A16*Press2	42.7	psig		
A17*R1	18.79	lbf		
A18*R2	-11.44	lbf		
A19*R3	26.16	lbf		
A20*R4	-2.55	lbf		
A21*R5	5.01	lbf		
A22*R6	5.51	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:35 - 00-Jan-72

## System identification data

## Process parameter list

11↓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.6	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.6	psig		
A16*Press2	-1.1	psig		
A17*R1	8.81	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.19	lbf		
A20*R4	-2.81	lbf		
A21*R5	3.46	lbf		
A22*R6	0.82	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:36 - 00-Jan-72

## System identification data

## Process parameter list ~

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	60.3	psig		
A 8*Pressure 2	47.9	psig		
A15*Press1	60.4	psig		
A16*Press2	48.0	psig		
A17*R1	19.92	lbf		
A18*R2	-11.20	lbf		
A19*R3	26.61	lbf		
A20*R4	-2.66	lbf		
A21*R5	5.22	lbf		
A22*R6	5.95	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:36 - 00-Jan-72

## System identification data

## Process parameter list 12\

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.75	lbf		
A18*R2	-12.70	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.78	lbf		
A21*R5	3.48	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:37 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	63.4	psig		
A 8*Pressure 2	50.6	psig		
A15*Press1	63.6	psig		
A16*Press2	50.7	psig		
A17*R1	20.58	lbf		
A18*R2	-11.14	lbf		
A19*R3	26.69	lbf		
A20*R4	-2.56	lbf		
A21*R5	5.25	lbf		
A22*R6	6.20	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:38 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.74	lbf		
A18*R2	-12.74	lbf		
A19*R3	23.23	lbf		
A20*R4	-2.84	lbf		
A21*R5	3.45	lbf		
A22*R6	0.82	lbf		

13/1

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:39 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.5	psig		
A 8*Pressure 2	49.6	psig		
A15*Press1	62.2	psig		
A16*Press2	49.5	psig		
A17*R1	20.11	lbf		
A18*R2	-11.09	lbf		
A19*R3	26.76	lbf		
A20*R4	-2.61	lbf		
A21*R5	5.24	lbf		
A22*R6	6.02	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:39 - 00-Jan-72

## System identification data

## Process parameter list

14/1

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.71	lbf		
A18*R2	-12.72	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.79	lbf		
A21*R5	3.47	lbf		
A22*R6	0.82	lbf		

14/2

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:40 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	68.7	psig		
A 8*Pressure 2	54.7	psig		
A15*Press1	69.0	psig		
A16*Press2	54.9	psig		
A17*R1	21.52	lbf		
A18*R2	-10.96	lbf		
A19*R3	26.99	lbf		
A20*R4	-2.54	lbf		
A21*R5	5.39	lbf		
A22*R6	6.60	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:40 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.73	lbf		
A18*R2	-12.67	lbf		
A19*R3	23.27	lbf		
A20*R4	-2.80	lbf		
A21*R5	3.47	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:41 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	69.1	psig		
A 8*Pressure 2	55.0	psig		
A15*Press1	69.3	psig		
A16*Press2	55.1	psig		
A17*R1	21.78	lbf		
A18*R2	-11.01	lbf		
A19*R3	26.90	lbf		
A20*R4	-2.52	lbf		
A21*R5	5.45	lbf		
A22*R6	6.64	lbf		

15V

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:41 - 00-Jan-72

## System identification data

## Process parameter list

164

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.69	lbf		
A18*R2	-12.68	lbf		
A19*R3	23.23	lbf		
A20*R4	-2.75	lbf		
A21*R5	3.48	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:42 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	74.0	psig		
A 8*Pressure 2	58.6	psig		
A15*Press1	74.0	psig		
A16*Press2	58.8	psig		
A17*R1	22.56	lbf		
A18*R2	-10.78	lbf		
A19*R3	27.21	lbf		
A20*R4	-2.57	lbf		
A21*R5	5.62	lbf		
A22*R6	6.91	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:43 - 00-Jan-72

## System identification data

## Process parameter list

174

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.73	lbf		
A18*R2	-12.69	lbf		
A19*R3	23.22	lbf		
A20*R4	-2.84	lbf		
A21*R5	3.46	lbf		
A22*R6	0.80	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:43 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	82.4	psig		
A 8*Pressure 2	65.3	psig		
A15*Press1	82.4	psig		
A16*Press2	65.5	psig		
A17*R1	24.19	lbf		
A18*R2	-10.53	lbf		
A19*R3	27.61	lbf		
A20*R4	-2.52	lbf		
A21*R5	5.71	lbf		
A22*R6	7.49	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:44 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.67	lbf		
A18*R2	-12.72	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.69	lbf		
A21*R5	3.42	lbf		
A22*R6	0.83	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:44 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	82.4	psig		
A 8*Pressure 2	65.4	psig		
A15*Press1	82.0	psig		
A16*Press2	65.0	psig		
A17*R1	23.90	lbf		
A18*R2	-10.48	lbf		
A19*R3	27.72	lbf		
A20*R4	-2.52	lbf		
A21*R5	5.70	lbf		
A22*R6	7.44	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:45 - 00-Jan-72

## System identification data

## Process parameter list

19

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.72	lbf		
A18*R2	-12.76	lbf		
A19*R3	23.25	lbf		
A20*R4	-2.78	lbf		
A21*R5	3.44	lbf		
A22*R6	0.81	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:46 - 00-Jan-72

## System identification data

## Process parameter list

-

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	83.3	psig		
A 8*Pressure 2	66.3	psig		
A15*Press1	83.1	psig		
A16*Press2	66.0	psig		
A17*R1	24.41	lbf		
A18*R2	-10.57	lbf		
A19*R3	27.63	lbf		
A20*R4	-2.51	lbf		
A21*R5	5.61	lbf		
A22*R6	7.62	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:46 - 00-Jan-72

## System identification data

## Process parameter list

20

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.77	lbf		
A18*R2	-12.79	lbf		
A19*R3	23.22	lbf		
A20*R4	-2.74	lbf		
A21*R5	3.42	lbf		
A22*R6	0.84	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:48 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	94.8	psig		
A 8*Pressure 2	74.9	psig		
A15*Press1	94.6	psig		
A16*Press2	74.8	psig		
A17*R1	26.69	lbf		
A18*R2	-10.05	lbf		
A19*R3	27.95	lbf		
A20*R4	-2.50	lbf		
A21*R5	5.97	lbf		
A22*R6	8.36	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:49 - 00-Jan-72

## System identification data

## Process parameter list

21

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.1	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.1	psig		
A17*R1	8.91	lbf		
A18*R2	-12.90	lbf		
A19*R3	23.28	lbf		
A20*R4	-2.59	lbf		
A21*R5	3.44	lbf		
A22*R6	0.87	lbf		

\*\*\*\*\* 12/14/90

\*\*\*\*\* Record 01:50 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	95.5	psig		
A 8*Pressure 2	75.6	psig		
A15*Press1	95.5	psig		
A16*Press2	75.5	psig		
A17*R1	26.95	lbf		
A18*R2	-10.13	lbf		
A19*R3	28.06	lbf		
A20*R4	-2.40	lbf		
A21*R5	6.02	lbf		
A22*R6	8.33	lbf		

## APPENDIX E

### December 19, 1990 Data

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:36 - 00-Jan-72

## System identification data

Process parameter list *#1*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.2	psig		
A17*R1	12.74	lbf		
A18*R2	-12.14	lbf		
A19*R3	23.02	lbf		
A20*R4	-2.10	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:37 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	15.2	psig		
A 8*Pressure 2	11.5	psig		
A15*Press1	15.3	psig		
A16*Press2	11.6	psig		
A17*R1	13.56	lbf		
A18*R2	-11.07	lbf		
A19*R3	24.01	lbf		
A20*R4	-2.09	lbf		
A21*R5	1.08	lbf		
A22*R6	-0.16	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:38 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.2	psig		
A17*R1	12.70	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.94	lbf		
A20*R4	-2.06	lbf		
A21*R5	2.04	lbf		
A22*R6	0.65	lbf		

*#2*  
*Channel 1 → PV*  
*Channel 2 → I*

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:39 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	17.7	psig		
A 8*Pressure 2	13.6	psig		
A15*Press1	17.7	psig		
A16*Press2	13.6	psig		
A17*R1	13.72	lbf		
A18*R2	-11.05	lbf		
A19*R3	24.07	lbf		
A20*R4	-2.08	lbf		
A21*R5	0.95	lbf		
A22*R6	-0.29	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:40 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.2	psig		
A17*R1	12.68	lbf		
A18*R2	-12.26	lbf		
A19*R3	22.90	lbf		
A20*R4	-2.06	lbf		
A21*R5	2.02	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:42 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	21.7	psig		
A 8*Pressure 2	16.7	psig		
A15*Press1	21.7	psig		
A16*Press2	16.8	psig		
A17*R1	13.93	lbf		
A18*R2	-10.65	lbf		
A19*R3	24.41	lbf		
A20*R4	-2.11	lbf		
A21*R5	0.75	lbf		
A22*R6	-0.46	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:42 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.2	psig		
A17*R1	12.70	lbf		
A18*R2	-12.16	lbf		
A19*R3	22.95	lbf		
A20*R4	-2.07	lbf		
A21*R5	2.04	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:43 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	28.1	psig		
A 8*Pressure 2	22.2	psig		
A15*Press1	27.6	psig		
A16*Press2	21.5	psig		
A17*R1	14.22	lbf		
A18*R2	-10.36	lbf		
A19*R3	24.67	lbf		
A20*R4	-2.08	lbf		
A21*R5	0.43	lbf		
A22*R6	-0.75	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:44 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.2	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.2	psig		
A17*R1	12.65	lbf		
A18*R2	-12.20	lbf		
A19*R3	22.92	lbf		
A20*R4	-2.08	lbf		
A21*R5	2.03	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:51 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.61	lbf		
A18*R2	-12.08	lbf		
A19*R3	23.09	lbf		
A20*R4	-2.05	lbf		
A21*R5	2.03	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:53 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	28.1	psig		
A 8*Pressure 2	21.9	psig		
A15*Press1	28.2	psig		
A16*Press2	21.9	psig		
A17*R1	14.41	lbf		
A18*R2	-10.35	lbf		
A19*R3	24.69	lbf		
A20*R4	-2.09	lbf		
A21*R5	0.39	lbf		
A22*R6	-0.78	lbf		

#5

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:55 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.58	lbf		
A18*R2	-12.06	lbf		
A19*R3	23.10	lbf		
A20*R4	-2.06	lbf		
A21*R5	2.03	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:58 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.8	psig		
A 8*Pressure 2	24.0	psig		
A15*Press1	30.9	psig		
A16*Press2	24.1	psig		
A17*R1	14.50	lbf		
A18*R2	-10.29	lbf		
A19*R3	24.69	lbf		
A20*R4	-2.08	lbf		
A21*R5	0.26	lbf		
A22*R6	-0.91	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:58 - 00-Jan-72

## System identification data

## Process parameter list #LJ

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.53	lbf		
A18*R2	-12.12	lbf		
A19*R3	22.99	lbf		
A20*R4	-2.07	lbf		
A21*R5	2.01	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 00:59 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.6	psig		
A 8*Pressure 2	23.1	psig		
A15*Press1	29.7	psig		
A16*Press2	23.1	psig		
A17*R1	14.47	lbf		
A18*R2	-10.30	lbf		
A19*R3	24.75	lbf		
A20*R4	-2.09	lbf		
A21*R5	0.33	lbf		
A22*R6	-0.83	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:00 - 00-Jan-72

## System identification data

Process parameter list *FF 7*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.54	lbf		
A18*R2	-12.09	lbf		
A19*R3	23.01	lbf		
A20*R4	-2.08	lbf		
A21*R5	2.02	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:00 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	33.9	psig		
A 8*Pressure 2	26.4	psig		
A15*Press1	33.8	psig		
A16*Press2	26.5	psig		
A17*R1	14.76	lbf		
A18*R2	-9.96	lbf		
A19*R3	24.93	lbf		
A20*R4	-2.02	lbf		
A21*R5	0.12	lbf		
A22*R6	-1.03	lbf		

81

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:01 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.54	lbf		
A18*R2	-12.07	lbf		
A19*R3	23.03	lbf		
A20*R4	-2.06	lbf		
A21*R5	2.03	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:02 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	35.9	psig		
A 8*Pressure 2	28.1	psig		
A15*Press1	36.0	psig		
A16*Press2	28.3	psig		
A17*R1	14.86	lbf		
A18*R2	-9.89	lbf		
A19*R3	25.08	lbf		
A20*R4	-2.08	lbf		
A21*R5	-0.00	lbf		
A22*R6	-1.15	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:02 - 00-Jan-72

## System identification data

## Process parameter list

91

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.53	lbf		
A18*R2	-12.04	lbf		
A19*R3	23.04	lbf		
A20*R4	-2.06	lbf		
A21*R5	2.03	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	38.8	psig		
A 8*Pressure 2	30.6	psig		
A15*Press1	38.9	psig		
A16*Press2	30.7	psig		
A17*R1	15.05	lbf		
A18*R2	-9.73	lbf		
A19*R3	25.23	lbf		
A20*R4	-2.07	lbf		
A21*R5	-0.16	lbf		
A22*R6	-1.31	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list #10 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.53	lbf		
A18*R2	-12.03	lbf		
A19*R3	23.05	lbf		
A20*R4	-2.05	lbf		
A21*R5	2.04	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:04 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	39.0	psig		
A 8*Pressure 2	29.6	psig		
A15*Press1	38.8	psig		
A16*Press2	30.7	psig		
A17*R1	15.05	lbf		
A18*R2	-9.72	lbf		
A19*R3	25.28	lbf		
A20*R4	-2.10	lbf		
A21*R5	-0.15	lbf		
A22*R6	-1.28	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:05 - 00-Jan-72

## System identification data

Process parameter list ~~+ 11/1~~

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.02	lbf		
A19*R3	23.06	lbf		
A20*R4	-2.05	lbf		
A21*R5	2.03	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:06 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	42.8	psig		
A 8*Pressure 2	33.9	psig		
A15*Press1	42.5	psig		
A16*Press2	33.7	psig		
A17*R1	15.24	lbf		
A18*R2	-9.57	lbf		
A19*R3	25.38	lbf		
A20*R4	-2.08	lbf		
A21*R5	-0.34	lbf		
A22*R6	-1.47	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:06 - 00-Jan-72

## System identification data

Process parameter list ~~+ 11/12~~

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.52	lbf		
A18*R2	-12.03	lbf		
A19*R3	23.06	lbf		
A20*R4	-2.03	lbf		
A21*R5	2.02	lbf		
A22*R6	0.66	lbf		

11/12 PRESS  
LOST P101

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:08 - 00-Jan-72

## System identification data

Process parameter list *F12*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.53	lbf		
A18*R2	-12.02	lbf		
A19*R3	23.08	lbf		
A20*R4	-2.05	lbf		
A21*R5	2.03	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:09 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.1	psig		
A 8*Pressure 2	39.1	psig		
A15*Press1	48.2	psig		
A16*Press2	38.4	psig		
A17*R1	15.62	lbf		
A18*R2	-9.37	lbf		
A19*R3	25.65	lbf		
A20*R4	-2.07	lbf		
A21*R5	-0.67	lbf		
A22*R6	-1.79	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:09 - 00-Jan-72

## System identification data

Process parameter list *S1/3*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.51	lbf		
A18*R2	-12.06	lbf		
A19*R3	23.00	lbf		
A20*R4	-2.04	lbf		
A21*R5	2.03	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:11 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.0	psig		
A 8*Pressure 2	39.0	psig		
A15*Press1	48.8	psig		
A16*Press2	39.0	psig		
A17*R1	15.66	lbf		
A18*R2	-9.28	lbf		
A19*R3	25.74	lbf		
A20*R4	-2.13	lbf		
A21*R5	-0.70	lbf		
A22*R6	-1.81	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:11 - 00-Jan-72

## System identification data

## Process parameter list

#14 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.53	lbf		
A18*R2	-12.05	lbf		
A19*R3	23.05	lbf		
A20*R4	-2.07	lbf		
A21*R5	2.03	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:12 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.8	psig		
A 8*Pressure 2	39.9	psig		
A15*Press1	49.9	psig		
A16*Press2	39.8	psig		
A17*R1	15.73	lbf		
A18*R2	-9.21	lbf		
A19*R3	25.78	lbf		
A20*R4	-2.05	lbf		
A21*R5	-0.74	lbf		
A22*R6	-1.86	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:12 - 00-Jan-72

## System identification data

Process parameter list *15V*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.02	lbf		
A19*R3	23.05	lbf		
A20*R4	-2.04	lbf		
A21*R5	2.04	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:13 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	53.9	psig		
A 8*Pressure 2	43.2	psig		
A15*Press1	54.1	psig		
A16*Press2	43.2	psig		
A17*R1	15.97	lbf		
A18*R2	-9.03	lbf		
A19*R3	25.98	lbf		
A20*R4	-2.08	lbf		
A21*R5	-0.96	lbf		
A22*R6	-2.08	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:14 - 00-Jan-72

## System identification data

Process parameter list *16V*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.05	lbf		
A19*R3	23.05	lbf		
A20*R4	-2.05	lbf		
A21*R5	2.03	lbf		
A22*R6	0.68	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:14 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.4	psig		
A 8*Pressure 2	49.0	psig		
A15*Press1	61.6	psig		
A16*Press2	49.3	psig		
A17*R1	16.43	lbf		
A18*R2	-8.70	lbf		
A19*R3	26.34	lbf		
A20*R4	-2.09	lbf		
A21*R5	-1.38	lbf		
A22*R6	-2.48	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:16 - 00-Jan-72

## System identification data

## Process parameter list 17

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.5	psig		
A17*R1	12.54	lbf		
A18*R2	-12.08	lbf		
A19*R3	23.20	lbf		
A20*R4	-2.31	lbf		
A21*R5	2.04	lbf		
A22*R6	0.69	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:17 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.4	psig		
A 8*Pressure 2	49.9	psig		
A15*Press1	62.7	psig		
A16*Press2	50.2	psig		
A17*R1	16.51	lbf		
A18*R2	-8.63	lbf		
A19*R3	26.45	lbf		
A20*R4	-2.04	lbf		
A21*R5	-1.42	lbf		
A22*R6	-2.55	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:17 - 00-Jan-72

## System identification data

## Process parameter list

18

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.5	psig		
A17*R1	12.55	lbf		
A18*R2	-12.07	lbf		
A19*R3	23.04	lbf		
A20*R4	-2.04	lbf		
A21*R5	2.04	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:18 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	68.4	psig		
A 8*Pressure 2	54.9	psig		
A15*Press1	68.7	psig		
A16*Press2	54.9	psig		
A17*R1	16.89	lbf		
A18*R2	-8.35	lbf		
A19*R3	26.76	lbf		
A20*R4	-2.10	lbf		
A21*R5	-1.77	lbf		
A22*R6	-2.86	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:19 - 00-Jan-72

## System identification data

## Process parameter list

~~NO~~

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.5	psig		
A17*R1	12.58	lbf		
A18*R2	-12.09	lbf		
A19*R3	23.02	lbf		
A20*R4	-2.02	lbf		
A21*R5	2.04	lbf		
A22*R6	0.67	lbf		

JUST PILOT

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:22 - 00-Jan-72

## System identification data

## Process parameter list

19

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.5	psig		
A17*R1	12.60	lbf		
A18*R2	-12.03	lbf		
A19*R3	23.07	lbf		
A20*R4	-2.01	lbf		
A21*R5	2.04	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:23 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	74.0	psig		
A 8*Pressure 2	60.1	psig		
A15*Press1	74.4	psig		
A16*Press2	60.2	psig		
A17*R1	17.23	lbf		
A18*R2	-8.13	lbf		
A19*R3	27.02	lbf		
A20*R4	-2.09	lbf		
A21*R5	-2.07	lbf		
A22*R6	-3.22	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

204

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.5	psig		
A17*R1	12.56	lbf		
A18*R2	-12.12	lbf		
A19*R3	23.00	lbf		
A20*R4	-2.02	lbf		
A21*R5	2.05	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	75.6	psig		
A 8*Pressure 2	61.2	psig		
A15*Press1	76.2	psig		
A16*Press2	61.6	psig		
A17*R1	17.32	lbf		
A18*R2	-8.07	lbf		
A19*R3	27.04	lbf		
A20*R4	-2.13	lbf		
A21*R5	-2.16	lbf		
A22*R6	-3.30	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:25 - 00-Jan-72

## System identification data

## Process parameter list

*Z/H*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.5	psig		
A17*R1	12.57	lbf		
A18*R2	-12.12	lbf		
A19*R3	22.95	lbf		
A20*R4	-2.01	lbf		
A21*R5	2.05	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:26 - 00-Jan-72

## System identification data

## Process parameter list

*Z/H*

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	79.5	psig		
A 8*Pressure 2	64.3	psig		
A15*Press1	79.7	psig		
A16*Press2	64.7	psig		
A17*R1	17.52	lbf		
A18*R2	-7.98	lbf		
A19*R3	27.19	lbf		
A20*R4	-2.16	lbf		
A21*R5	-2.37	lbf		
A22*R6	-3.49	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:26 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.5	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.5	psig		
A17*R1	12.58	lbf		
A18*R2	-12.13	lbf		
A19*R3	22.97	lbf		
A20*R4	-2.01	lbf		
A21*R5	2.06	lbf		
A22*R6	0.68	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:27 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	94.3	psig		
A 8*Pressure 2	76.6	psig		
A15*Press1	94.8	psig		
A16*Press2	77.2	psig		
A17*R1	18.40	lbf		
A18*R2	-7.25	lbf		
A19*R3	27.87	lbf		
A20*R4	-2.34	lbf		
A21*R5	-3.21	lbf		
A22*R6	-4.38	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:33 - 00-Jan-72

## System identification data

Process parameter list 1

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.72	lbf		
A18*R2	-12.07	lbf		
A19*R3	23.16	lbf		
A20*R4	-1.92	lbf		
A21*R5	2.09	lbf		
A22*R6.	0.68	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:35 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	11.4	psig		
A 8*Pressure 2	8.2	psig		
A15*Press1	11.5	psig		
A16*Press2	8.2	psig		
A17*R1	15.08	lbf		
A18*R2	-12.15	lbf		
A19*R3	23.18	lbf		
A20*R4	-1.82	lbf		
A21*R5	0.99	lbf		
A22*R6	0.33	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:35 - 00-Jan-72

## System identification data

Process parameter list 2

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.67	lbf		
A18*R2	-12.17	lbf		
A19*R3	23.07	lbf		
A20*R4	-1.94	lbf		
A21*R5	2.07	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:37 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.8	psig		
A 8*Pressure 2	12.3	psig		
A15*Press1	16.8	psig		
A16*Press2	12.4	psig		
A17*R1	15.89	lbf		
A18*R2	-12.23	lbf		
A19*R3	23.12	lbf		
A20*R4	-1.86	lbf		
A21*R5	0.59	lbf		
A22*R6	0.19	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:37 - 00-Jan-72

## System identification data

## Process parameter list

43 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.62	lbf		
A18*R2	-12.20	lbf		
A19*R3	23.02	lbf		
A20*R4	-1.94	lbf		
A21*R5	2.05	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:38 - 00-Jan-72

## System identification data

## Process parameter list

43 ✓

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.6	psig		
A 8*Pressure 2	22.9	psig		
A15*Press1	29.3	psig		
A16*Press2	22.5	psig		
A17*R1	18.01	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.04	lbf		
A20*R4	-1.80	lbf		
A21*R5	-0.37	lbf		
A22*R6	-0.16	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:39 - 00-Jan-72

## System identification data

Process parameter list 44

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.62	lbf		
A18*R2	-12.22	lbf		
A19*R3	22.97	lbf		
A20*R4	-1.94	lbf		
A21*R5	2.04	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:41 - 00-Jan-72

## System identification data

Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	31.7	psig		
A 8*Pressure 2	24.4	psig		
A15*Press1	31.8	psig		
A16*Press2	24.6	psig		
A17*R1	18.37	lbf		
A18*R2	-12.39	lbf		
A19*R3	22.98	lbf		
A20*R4	-1.82	lbf		
A21*R5	-0.56	lbf		
A22*R6	-0.23	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:41 - 00-Jan-72

## System identification data

Process parameter list 45

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.60	lbf		
A18*R2	-12.25	lbf		
A19*R3	22.97	lbf		
A20*R4	-1.98	lbf		
A21*R5	2.05	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:42 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	37.2	psig		
A 8*Pressure 2	29.1	psig		
A15*Press1	37.9	psig		
A16*Press2	29.7	psig		
A17*R1	19.45	lbf		
A18*R2	-12.45	lbf		
A19*R3	22.92	lbf		
A20*R4	-1.83	lbf		
A21*R5	-1.04	lbf		
A22*R6	-0.40	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:43 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.61	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.97	lbf		
A20*R4	-1.97	lbf		
A21*R5	2.06	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:44 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	39.0	psig		
A 8*Pressure 2	30.6	psig		
A15*Press1	38.7	psig		
A16*Press2	30.3	psig		
A17*R1	19.57	lbf		
A18*R2	-12.47	lbf		
A19*R3	22.95	lbf		
A20*R4	-1.82	lbf		
A21*R5	-1.09	lbf		
A22*R6	-0.43	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:44 - 00-Jan-72

## System identification data

Process parameter list THV

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.60	lbf		
A18*R2	-12.24	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:45 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	43.8	psig		
A 8*Pressure 2	34.5	psig		
A15*Press1	43.6	psig		
A16*Press2	34.4	psig		
A17*R1	20.41	lbf		
A18*R2	-12.46	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.78	lbf		
A21*R5	-1.44	lbf		
A22*R6	-0.57	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:46 - 00-Jan-72

## System identification data

Process parameter list JG

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.60	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:48 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	44.5	psig		
A 8*Pressure 2	35.3	psig		
A15*Press1	44.7	psig		
A16*Press2	35.3	psig		
A17*R1	20.61	lbf		
A18*R2	-12.50	lbf		
A19*R3	23.00	lbf		
A20*R4	-1.80	lbf		
A21*R5	-1.55	lbf		
A22*R6	-0.62	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:50 - 00-Jan-72

## System identification data

Process parameter list *for 91*

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.3	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.3	psig		
A17*R1	12.61	lbf		
A18*R2	-12.24	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.05	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:51 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	47.2	psig		
A 8*Pressure 2	37.5	psig		
A15*Press1	47.4	psig		
A16*Press2	37.5	psig		
A17*R1	21.06	lbf		
A18*R2	-12.51	lbf		
A19*R3	22.90	lbf		
A20*R4	-1.87	lbf		
A21*R5	-1.75	lbf		
A22*R6	-0.69	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:51 - 00-Jan-72

## System identification data

## Process parameter list

T/0V

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.60	lbf		
A18*R2	-12.24	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.96	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:52 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	54.2	psig		
A 8*Pressure 2	43.3	psig		
A15*Press1	54.4	psig		
A16*Press2	43.3	psig		
A17*R1	22.22	lbf		
A18*R2	-12.53	lbf		
A19*R3	22.91	lbf		
A20*R4	-1.82	lbf		
A21*R5	-2.28	lbf		
A22*R6	-0.91	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:52 - 00-Jan-72

## System identification data

## Process parameter list

T/IV

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.59	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:53 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	59.1	psig		
A 8*Pressure 2	47.2	psig		
A15*Press1	59.7	psig		
A16*Press2	47.7	psig		
A17*R1	23.11	lbf		
A18*R2	-12.59	lbf		
A19*R3	22.90	lbf		
A20*R4	-1.92	lbf		
A21*R5	-2.68	lbf		
A22*R6	-1.05	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:53 - 00-Jan-72

## System identification data

Process parameter list #12

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.57	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.95	lbf		
A20*R4	-1.96	lbf		
A21*R5	2.07	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:56 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.7	psig		
A 8*Pressure 2	50.2	psig		
A15*Press1	63.0	psig		
A16*Press2	50.4	psig		
A17*R1	23.62	lbf		
A18*R2	-12.60	lbf		
A19*R3	22.90	lbf		
A20*R4	-1.89	lbf		
A21*R5	-2.97	lbf		
A22*R6	-1.19	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:56 - 00-Jan-72

## System identification data

Process parameter list #Bv

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.59	lbf		
A18*R2	-12.25	lbf		
A19*R3	22.93	lbf		
A20*R4	-1.96	lbf		
A21*R5	2.06	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:57 - 00-Jan-72

## System identification data

Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.1	psig		
A 8*Pressure 2	49.6	psig		
A15*Press1	62.6	psig		
A16*Press2	50.0	psig		
A17*R1	23.51	lbf		
A18*R2	-12.64	lbf		
A19*R3	22.89	lbf		
A20*R4	-1.89	lbf		
A21*R5	-2.93	lbf		
A22*R6	-1.16	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:57 - 00-Jan-72

## System identification data

Process parameter list #CIV

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.61	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.93	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.04	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:58 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	67.9	psig		
A 8*Pressure 2	54.6	psig		
A15*Press1	67.9	psig		
A16*Press2	54.5	psig		
A17*R1	24.39	lbf		
A18*R2	-12.68	lbf		
A19*R3	22.84	lbf		
A20*R4	-1.85	lbf		
A21*R5	-3.31	lbf		
A22*R6	-1.31	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:58 - 00-Jan-72

## System identification data

## Process parameter list #15

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.93	lbf		
A20*R4	-1.93	lbf		
A21*R5	2.07	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:59 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	68.2	psig		
A 8*Pressure 2	54.8	psig		
A15*Press1	68.2	psig		
A16*Press2	54.6	psig		
A17*R1	24.45	lbf		
A18*R2	-12.66	lbf		
A19*R3	22.81	lbf		
A20*R4	-1.86	lbf		
A21*R5	-3.34	lbf		
A22*R6	-1.35	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 01:59 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.20	lbf		
A19*R3	22.98	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.06	lbf		
A22*R6	0.66	lbf		

#16

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:00 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	73.1	psig		
A 8*Pressure 2	58.5	psig		
A15*Press1	72.4	psig		
A16*Press2	58.1	psig		
A17*R1	25.05	lbf		
A18*R2	-12.71	lbf		
A19*R3	22.80	lbf		
A20*R4	-1.92	lbf		
A21*R5	-3.68	lbf		
A22*R6	-1.48	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:01 - 00-Jan-72

## System identification data

## Process parameter list

#17

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.52	lbf		
A18*R2	-12.20	lbf		
A19*R3	22.93	lbf		
A20*R4	-1.93	lbf		
A21*R5	2.06	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:02 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	81.2	psig		
A 8*Pressure 2	65.2	psig		
A15*Press1	81.0	psig		
A16*Press2	65.2	psig		
A17*R1	26.60	lbf		
A18*R2	-12.77	lbf		
A19*R3	22.81	lbf		
A20*R4	-1.92	lbf		
A21*R5	-4.37	lbf		
A22*R6	-1.80	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:02 - 00-Jan-72

## System identification data

## Process parameter list #18

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.22	lbf		
A19*R3	22.96	lbf		
A20*R4	-1.93	lbf		
A21*R5	2.07	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:03 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	80.5	psig		
A 8*Pressure 2	64.6	psig		
A15*Press1	80.4	psig		
A16*Press2	64.7	psig		
A17*R1	26.47	lbf		
A18*R2	-12.77	lbf		
A19*R3	22.86	lbf		
A20*R4	-1.87	lbf		
A21*R5	-4.31	lbf		
A22*R6	-1.77	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:03 - 00-Jan-72

## System identification data

## Process parameter list /9 V

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.57	lbf		
A18*R2	-12.22	lbf		
A19*R3	22.98	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.07	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:04 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	81.1	psig		
A 8*Pressure 2	65.2	psig		
A15*Press1	81.5	psig		
A16*Press2	65.7	psig		
A17*R1	26.64	lbf		
A18*R2	-12.84	lbf		
A19*R3	22.89	lbf		
A20*R4	-1.81	lbf		
A21*R5	-4.39	lbf		
A22*R6	-1.82	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:04 - 00-Jan-72

## System identification data

## Process parameter list

20 V

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.4	psig		
A17*R1	12.55	lbf		
A18*R2	-12.23	lbf		
A19*R3	22.95	lbf		
A20*R4	-1.94	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:05 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	93.1	psig		
A 8*Pressure 2	75.2	psig		
A15*Press1	93.1	psig		
A16*Press2	75.0	psig		
A17*R1	28.55	lbf		
A18*R2	-12.99	lbf		
A19*R3	22.88	lbf		
A20*R4	-1.82	lbf		
A21*R5	-5.30	lbf		
A22*R6	-2.23	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:06 - 00-Jan-72

## System identification data

## Process parameter list

STV

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.7	psig		
A 8*Pressure 2	-1.4	psig		
A15*Press1	-2.7	psig		
A16*Press2	-1.4	psig		
A17*R1	12.58	lbf		
A18*R2	-12.27	lbf		
A19*R3	22.94	lbf		
A20*R4	-1.93	lbf		
A21*R5	2.07	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* 12/19/90

\*\*\*\*\* Record 02:06 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Monitor \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	104.5	psig		
A 8*Pressure 2	84.4	psig		
A15*Press1	104.5	psig		
A16*Press2	84.4	psig		
A17*R1	30.53	lbf		
A18*R2	-13.18	lbf		
A19*R3	22.79	lbf		
A20*R4	-1.86	lbf		
A21*R5	-6.20	lbf		
A22*R6	-2.65	lbf		

## APPENDIX F

### January 24, 1991 Data

\*\*\*\*\* PLUG TEST, 1/24/91

System identification data

\*\*\*\*\* Record 00:03 - 00-Jan-72

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.1	psig		
A 8*Pressure 2	-2.3	psig		
A15*Press1	-0.5	psig		
A16*Press2	-2.7	psig		
A17*R1	12.45	lbf		
A18*R2	-12.33	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.82	lbf		
A21*R5	2.07	lbf		
A22*R6	0.62	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

System identification data

\*\*\*\*\* Record 00:05 - 00-Jan-72

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	22.8	psig		
A 8*Pressure 2	20.7	psig		
A15*Press1	23.0	psig		
A16*Press2	20.8	psig		
A17*R1	12.64	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.68	lbf		
A20*R4	-1.91	lbf		
A21*R5	0.83	lbf		
A22*R6	-0.44	lbf		

$P = 23.5 \text{ psig}$   $R_4 = .09$   
 $R_1 = 0.190$   $R_5 = -1.24$   
 $R_2 = -.05$   $R_6 = -1.06$   
 $R_3 = -0.09$

2

\*\*\*\*\* PLUG TEST, 1/24/91

System identification data

\*\*\*\*\* Record 00:05 - 00-Jan-72

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.7	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.7	psig		
A16*Press2	-2.8	psig		
A17*R1	12.52	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.08	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:06 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	48.4	psig	P2	49.1
A 8*Pressure 2	46.1	psig	P5	-2.60
A15*Press1	48.6	psig	R1	0.52
A16*Press2	46.3	psig	R6	-2.32
A17*R1	12.84	lbf	R2	-0.17
A18*R2	-12.52	lbf	R3	-0.22
A19*R3	23.56	lbf	R4	-0.11
A20*R4	-1.99	lbf		
A21*R5	-0.52	lbf		
A22*R6	-1.69	lbf		

$P_2 = 49.1$   
 $P_5 = -2.60$   
 $R_1 = 0.52$   
 $R_6 = -2.32$   
 $R_2 = -0.17$   
 $R_3 = -0.22$   
 $R_4 = -0.11$

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:07 - 00-Jan-72

## System identification data

## Process parameter list

3-

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.7	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.7	psig		
A16*Press2	-2.8	psig		
A17*R1	12.50	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.09	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:07 - 00-Jan-72

## System identification data

## Process parameter list

3-

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	63.6	psig	P2	64.3
A 8*Pressure 2	61.4	psig	P5	-7.43
A15*Press1	63.8	psig	R1	0.44
A16*Press2	61.5	psig	R6	-3.12
A17*R1	12.94	lbf	R2	-0.23
A18*R2	-12.60	lbf	R3	-0.27
A19*R3	23.50	lbf	R4	-0.27
A20*R4	-2.15	lbf		
A21*R5	-1.34	lbf		
A22*R6	-2.49	lbf		

$P_2 = 64.3$   
 $P_5 = -7.43$   
 $R_1 = 0.44$   
 $R_6 = -3.12$   
 $R_2 = -0.23$   
 $R_3 = -0.27$   
 $R_4 = -0.27$

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:08 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.7	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.7	psig		
A16*Press2	-2.8	psig		
A17*R1	12.52	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.09	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:09 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	66.3	psig	$P_7 = 67.0$	$Q_C \sim -3.57$
A 8*Pressure 2	64.1	psig	$P_8 = -0.42$	
A15*Press1	66.5	psig		
A16*Press2	64.2	psig		$P_6 = -3.26$
A17*R1	12.94	lbf	$R_1 = -0.31$	
A18*R2	-12.67	lbf	$R_2 = -0.31$	
A19*R3	23.47	lbf		
A20*R4	-2.08	lbf		
A21*R5	-1.48	lbf		
A22*R6	-2.63	lbf	$R_6 = -0.2$	

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:09 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.7	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.53	lbf		
A18*R2	-12.31	lbf		
A19*R3	23.88	lbf		
A20*R4	-1.95	lbf		
A21*R5	2.09	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:10 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	72.4	psig		$P_2 = 75.3$
A 8*Pressure 2	70.2	psig		$R_1 = .44$
A15*Press1	72.5	psig		$R_5 = -5.89$
A16*Press2	70.2	psig		
A17*R1	12.97	lbf		$R_2 = -.57$
A18*R2	-12.68	lbf		$R_6 = 2.3$
A19*R3	23.42	lbf		$R_3 = -.46$
A20*R4	-2.10	lbf		
A21*R5	-1.80	lbf		
A22*R6	-2.94	lbf		$R_4 = -1.5$

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:11 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.52	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.79	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.62	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:12 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	86.6	psig		$P_2 = 86.0$
A 8*Pressure 2	84.5	psig		
A15*Press1	86.2	psig		$R_1 = .47$
A16*Press2	84.0	psig		$R_5 = -4.62$
A17*R1	12.99	lbf		
A18*R2	-12.78	lbf		$R_2 = .41$
A19*R3	23.38	lbf		$R_6 = -4.33$
A20*R4	-2.20	lbf		$R_3 = -.41$
A21*R5	-2.54	lbf		
A22*R6	-3.71	lbf		$R_4 = -.53$

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:13 -

67  
00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.51	lbf		
A18*R2	-12.39	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.09	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:14 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	36.9	psig	P = 57.7	
A 8*Pressure 2	34.8	psig	L <sub>1</sub> = .27	R <sub>5</sub> = -2.1
A15*Press1	37.1	psig		
A16*Press2	34.9	psig		
A17*R1	12.78	lbf	R <sub>2</sub> = -.09	R <sub>6</sub> = -1.75
A18*R2	-12.48	lbf		
A19*R3	23.61	lbf	R <sub>3</sub> = -.16	
A20*R4	-1.94	lbf		
A21*R5	0.08	lbf		
A22*R6	-1.11	lbf	R <sub>4</sub> = -.07	

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:15 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.54	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.09	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:15 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	60.8	psig	P	61.6
A 8*Pressure 2	58.6	psig		
A15*Press1	61.0	psig	R <sub>1</sub>	.4
A16*Press2	58.8	psig	R <sub>2</sub>	-12.63
A17*R1	12.94	lbf	R <sub>7</sub>	-23.49
A18*R2	-12.63	lbf	R <sub>3</sub>	-2.04
A19*R3	23.49	lbf	R <sub>4</sub>	-1.19
A20*R4	-2.04	lbf	R <sub>5</sub>	-2.33
A21*R5	1.19	lbf		
A22*R6	-2.33	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:16 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.54	lbf	R <sub>1</sub>	12.54
A18*R2	-12.37	lbf	R <sub>2</sub>	-12.37
A19*R3	23.78	lbf	R <sub>3</sub>	23.78
A20*R4	-1.88	lbf	R <sub>4</sub>	-1.88
A21*R5	2.09	lbf	R <sub>5</sub>	2.09
A22*R6	0.64	lbf	R <sub>6</sub>	0.64

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:17 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	55.3	psig	P	56.0
A 8*Pressure 2	53.2	psig	R <sub>1</sub>	.37
A15*Press1	55.4	psig	R <sub>2</sub>	-12.59
A16*Press2	53.2	psig	R <sub>3</sub>	23.51
A17*R1	12.91	lbf	R <sub>4</sub>	-2.01
A18*R2	-12.59	lbf	R <sub>5</sub>	-0.90
A19*R3	23.51	lbf	R <sub>6</sub>	-2.04
A20*R4	-2.01	lbf		
A21*R5	0.90	lbf		
A22*R6	-2.04	lbf		

R<sub>5</sub> -2.99R<sub>6</sub> -2.68

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:17

10 Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.53	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.79	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.09	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:19 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	72.2	psig	P	73.0
A 8*Pressure 2	70.1	psig	R <sub>1</sub>	.46
A15*Press1	72.3	psig	R <sub>2</sub>	-.31
A16*Press2	70.2	psig	R <sub>3</sub>	-.36
A17*R1	12.99	lbf	R <sub>4</sub>	-.24
A18*R2	-12.67	lbf		
A19*R3	23.43	lbf		
A20*R4	-2.11	lbf		
A21*R5	-1.80	lbf		
A22*R6	-2.93	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:20 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.8	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.8	psig		
A16*Press2	-2.8	psig		
A17*R1	12.53	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.09	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* PLUG TEST, 1/24/91

\*\*\*\*\* Record 00:21 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.0	psig	P 49.7	R5 -2.65
A 8*Pressure 2	46.9	psig		
A15*Press1	49.1	psig	R1 0.26	
A16*Press2	46.9	psig		
A17*R1	12.89	lbf	R2 -1.18	R6 -2.34
A18*R2	-12.54	lbf		
A19*R3	23.53	lbf		
A20*R4	-1.98	lbf		
A21*R5	-0.56	lbf		
A22*R6	-1.70	lbf	R3 -2.4	
			R4 -1.1	

## APPENDIX G

### Stastical Raw Data

1 V

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:27 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.53	lbf		
A18*R2	-12.39	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.07	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:28 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.8	psig		
A 8*Pressure 2	10.0	psig		
A15*Press1	7.8	psig		
A16*Press2	10.0	psig		
A17*R1	13.27	lbf		
A18*R2	-11.67	lbf		
A19*R3	24.42	lbf		
A20*R4	-1.88	lbf		
A21*R5	1.39	lbf		
A22*R6	0.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:29 - 00-Jan-72

## System identification data

## Process parameter list

2 V

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.52	lbf		
A18*R2	-12.42	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.08	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:29 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.8	psig		
A 8*Pressure 2	10.1	psig		
A15*Press1	7.8	psig		
A16*Press2	10.1	psig		
A17*R1	13.26	lbf		
A18*R2	-11.76	lbf		
A19*R3	24.35	lbf		
A20*R4	-1.88	lbf		
A21*R5	1.36	lbf		
A22*R6	0.07	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:30 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.50	lbf		
A19*R3	23.67	lbf		
A20*R4	-1.89	lbf		
A21*R5	2.07	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:30 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.8	psig		
A 8*Pressure 2	10.0	psig		
A15*Press1	7.8	psig		
A16*Press2	10.0	psig		
A17*R1	13.26	lbf		
A18*R2	-11.70	lbf		
A19*R3	24.39	lbf		
A20*R4	-1.88	lbf		
A21*R5	1.37	lbf		
A22*R6	0.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:31 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.50	lbf		
A18*R2	-12.42	lbf		
A19*R3	23.73	lbf		
A20*R4	-1.89	lbf		
A21*R5	2.07	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:32 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.8	psig		
A 8*Pressure 2	10.0	psig		
A15*Press1	7.8	psig		
A16*Press2	10.1	psig		
A17*R1	13.23	lbf		
A18*R2	-11.74	lbf		
A19*R3	24.37	lbf		
A20*R4	-1.92	lbf		
A21*R5	1.37	lbf		
A22*R6	0.07	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:32 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.44	lbf		
A19*R3	23.70	lbf		
A20*R4	-1.89	lbf		
A21*R5	2.08	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:33 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A 7*Pressure 1		7.9	psig		
A 8*Pressure 2		10.2	psig		
A15*Press1		7.9	psig		
A16*Press2		10.2	psig		
A17*R1		13.26	lbf		
A18*R2		-11.68	lbf		
A19*R3		24.42	lbf		
A20*R4		-1.92	lbf		
A21*R5		1.35	lbf		
A22*R6		0.06	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:33 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A 7*Pressure 1		-0.9	psig		
A 8*Pressure 2		-2.8	psig		
A15*Press1		-0.9	psig		
A16*Press2		-2.8	psig		
A17*R1		12.47	lbf		
A18*R2		-12.44	lbf		
A19*R3		23.72	lbf		
A20*R4		-1.90	lbf		
A21*R5		2.07	lbf		
A22*R6		0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:34 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A 7*Pressure 1		7.7	psig		
A 8*Pressure 2		10.0	psig		
A15*Press1		7.8	psig		
A16*Press2		10.0	psig		
A17*R1		13.23	lbf		
A18*R2		-11.69	lbf		
A19*R3		24.41	lbf		
A20*R4		-1.90	lbf		
A21*R5		1.37	lbf		
A22*R6		0.07	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:35 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-0.9	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-0.9	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.41	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.89	lbf		
A21*R5	2.06	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:35 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.7	psig		
A 8*Pressure 2	9.9	psig		
A15*Press1	7.7	psig		
A16*Press2	10.0	psig		
A17*R1	13.23	lbf		
A18*R2	-11.65	lbf		
A19*R3	24.45	lbf		
A20*R4	-1.89	lbf		
A21*R5	1.37	lbf		
A22*R6	0.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:36 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.07	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:36 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	8.0	psig		
A 8*Pressure 2	10.2	psig		
A15*Press1	7.9	psig		
A16*Press2	10.1	psig		
A17*R1	13.21	lbf		
A18*R2	-11.63	lbf		
A19*R3	24.44	lbf		
A20*R4	-1.88	lbf		
A21*R5	1.35	lbf		
A22*R6	0.07	lbf		

9-J

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:37 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.06	lbf		
A22*R6	0.63	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:38 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.7	psig		
A 8*Pressure 2	9.9	psig		
A15*Press1	7.7	psig		
A16*Press2	10.0	psig		
A17*R1	13.25	lbf		
A18*R2	-11.59	lbf		
A19*R3	24.47	lbf		
A20*R4	-1.90	lbf		
A21*R5	1.39	lbf		
A22*R6	0.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:38 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:39 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	7.7	psig		
A 8*Pressure 2	10.1	psig		
A15*Press1	7.8	psig		
A16*Press2	10.1	psig		
A17*R1	13.20	lbf		
A18*R2	-11.61	lbf		
A19*R3	24.46	lbf		
A20*R4	-1.90	lbf		
A21*R5	1.38	lbf		
A22*R6	0.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:41 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.46	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.71	lbf		
A20*R4	-1.89	lbf		
A21*R5	2.08	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:42 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.9	psig		
A 8*Pressure 2	21.6	psig		
A15*Press1	16.9	psig		
A16*Press2	21.7	psig		
A17*R1	13.93	lbf		
A18*R2	-11.01	lbf		
A19*R3	25.05	lbf		
A20*R4	-1.89	lbf		
A21*R5	0.73	lbf		
A22*R6	-0.46	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:42 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.73	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:43 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.9	psig		
A 8*Pressure 2	21.7	psig		
A15*Press1	16.9	psig		
A16*Press2	21.7	psig		
A17*R1	13.97	lbf		
A18*R2	-11.06	lbf		
A19*R3	25.01	lbf		
A20*R4	-1.88	lbf		
A21*R5	0.74	lbf		
A22*R6	-0.46	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:43 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.72	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:44 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.9	psig		
A 8*Pressure 2	21.7	psig		
A15*Press1	17.0	psig		
A16*Press2	21.8	psig		
A17*R1	13.98	lbf		
A18*R2	-11.06	lbf		
A19*R3	24.99	lbf		
A20*R4	-1.91	lbf		
A21*R5	0.72	lbf		
A22*R6	-0.47	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:45 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.0	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.0	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.71	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:46 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.9	psig		
A 8*Pressure 2	21.9	psig		
A15*Press1	17.0	psig		
A16*Press2	21.8	psig		
A17*R1	13.95	lbf		
A18*R2	-11.01	lbf		
A19*R3	25.06	lbf		
A20*R4	-1.91	lbf		
A21*R5	0.73	lbf		
A22*R6	-0.45	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:46 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:47 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.8	psig		
A 8*Pressure 2	21.6	psig		
A15*Press1	16.8	psig		
A16*Press2	21.7	psig		
A17*R1	13.96	lbf		
A18*R2	-10.99	lbf		
A19*R3	25.08	lbf		
A20*R4	-1.87	lbf		
A21*R5	0.76	lbf		
A22*R6	-0.42	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:47

-67 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:48 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.8	psig		
A 8*Pressure 2	21.5	psig		
A15*Press1	16.9	psig		
A16*Press2	21.7	psig		
A17*R1	13.92	lbf		
A18*R2	-11.01	lbf		
A19*R3	25.06	lbf		
A20*R4	-1.86	lbf		
A21*R5	0.74	lbf		
A22*R6	-0.43	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:49 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.33	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.07	lbf		
A22*R6	0.64	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:49 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	17.2	psig		
A 8*Pressure 2	22.0	psig		
A15*Press1	16.8	psig		
A16*Press2	21.7	psig		
A17*R1	13.98	lbf		
A18*R2	-11.01	lbf		
A19*R3	25.09	lbf		
A20*R4	-1.89	lbf		
A21*R5	0.76	lbf		
A22*R6	-0.43	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:49 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:50 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.6	psig		
A 8*Pressure 2	21.5	psig		
A15*Press1	16.7	psig		
A16*Press2	21.6	psig		
A17*R1	13.97	lbf		
A18*R2	-11.02	lbf		
A19*R3	25.06	lbf		
A20*R4	-1.85	lbf		
A21*R5	0.76	lbf		
A22*R6	-0.42	lbf		

97

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:50 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:51 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.7	psig		
A 8*Pressure 2	21.6	psig		
A15*Press1	16.8	psig		
A16*Press2	21.6	psig		
A17*R1	13.96	lbf		
A18*R2	-11.02	lbf		
A19*R3	25.07	lbf		
A20*R4	-1.85	lbf		
A21*R5	0.76	lbf		
A22*R6	-0.41	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:51 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:52 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	16.9	psig		
A 8*Pressure 2	21.8	psig		
A15*Press1	16.9	psig		
A16*Press2	21.8	psig		
A17*R1	13.94	lbf		
A18*R2	-11.03	lbf		
A19*R3	25.01	lbf		
A20*R4	-1.91	lbf		
A21*R5	0.75	lbf		
A22*R6	-0.43	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:53 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.34	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:53 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.0	psig		
A 8*Pressure 2	37.5	psig		
A15*Press1	30.2	psig		
A16*Press2	37.9	psig		
A17*R1	14.97	lbf		
A18*R2	-10.18	lbf		
A19*R3	25.95	lbf		
A20*R4	-1.95	lbf		
A21*R5	-0.12	lbf		
A22*R6	-1.18	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:54 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.50	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:55 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.7	psig		
A 8*Pressure 2	37.4	psig		
A15*Press1	30.0	psig		
A16*Press2	37.6	psig		
A17*R1	14.96	lbf		
A18*R2	-10.24	lbf		
A19*R3	25.81	lbf		
A20*R4	-1.91	lbf		
A21*R5	-0.11	lbf		
A22*R6	-1.17	lbf		

3 →

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:55 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.1	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.85	lbf		
A21*R5	2.07	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:57 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.4	psig		
A 8*Pressure 2	38.0	psig		
A15*Press1	30.2	psig		
A16*Press2	37.8	psig		
A17*R1	14.95	lbf		
A18*R2	-10.27	lbf		
A19*R3	25.78	lbf		
A20*R4	-1.98	lbf		
A21*R5	-0.14	lbf		
A22*R6	-1.19	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:57 - 00-Jan-72

4-7

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.1	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:58 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.8	psig		
A 8*Pressure 2	37.5	psig		
A15*Press1	30.0	psig		
A16*Press2	37.6	psig		
A17*R1	14.93	lbf		
A18*R2	-10.26	lbf		
A19*R3	25.82	lbf		
A20*R4	-1.87	lbf		
A21*R5	-0.10	lbf		
A22*R6	-1.16	lbf		

S\

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:58 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.38	lbf		
A19*R3	23.73	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:59 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.0	psig		
A 8*Pressure 2	37.6	psig		
A15*Press1	29.8	psig		
A16*Press2	37.4	psig		
A17*R1	14.90	lbf		
A18*R2	10.23	lbf		
A19*R3	25.84	lbf		
A20*R4	-1.88	lbf		
A21*R5	-0.10	lbf		
A22*R6	-1.17	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:59 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.8	psig		
A 8*Pressure 2	37.5	psig		
A15*Press1	29.9	psig		
A16*Press2	37.6	psig		
A17*R1	14.91	lbf		
A18*R2	-10.25	lbf		
A19*R3	25.82	lbf		
A20*R4	-1.90	lbf		
A21*R5	-0.11	lbf		
A22*R6	-1.20	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 00:59 - 00-Jan-72

## System identification data

## Process parameter list

67

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.49	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.65	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:00 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.3	psig		
A 8*Pressure 2	37.9	psig		
A15*Press1	30.0	psig		
A16*Press2	37.6	psig		
A17*R1	14.93	lbf		
A18*R2	-10.26	lbf		
A19*R3	25.86	lbf		
A20*R4	-1.89	lbf		
A21*R5	-0.13	lbf		
A22*R6	-1.17	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:01 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.88	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:01 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.7	psig		
A 8*Pressure 2	37.3	psig		
A15*Press1	29.9	psig		
A16*Press2	37.5	psig		
A17*R1	14.95	lbf		
A18*R2	-10.24	lbf		
A19*R3	25.89	lbf		
A20*R4	-1.85	lbf		
A21*R5	-0.10	lbf		
A22*R6	-1.15	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:02 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.50	lbf		
A18*R2	-12.34	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.08	lbf		
A22*R6	0.66	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:02 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.4	psig		
A 8*Pressure 2	37.3	psig		
A15*Press1	29.7	psig		
A16*Press2	37.4	psig		
A17*R1	14.95	lbf		
A18*R2	-10.25	lbf		
A19*R3	25.84	lbf		
A20*R4	-1.81	lbf		
A21*R5	-0.10	lbf		
A22*R6	-1.15	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.48	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:03 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	29.6	psig		
A 8*Pressure 2	37.4	psig		
A15*Press1	30.0	psig		
A16*Press2	37.7	psig		
A17*R1	14.90	lbf		
A18*R2	-10.22	lbf		
A19*R3	25.86	lbf		
A20*R4	-1.92	lbf		
A21*R5	-0.11	lbf		
A22*R6	-1.17	lbf		

107

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:04 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.07	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:05 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	30.2	psig		
A 8*Pressure 2	37.9	psig		
A15*Press1	30.1	psig		
A16*Press2	37.7	psig		
A17*R1	14.93	lbf		
A18*R2	-10.28	lbf		
A19*R3	25.81	lbf		
A20*R4	-1.88	lbf		
A21*R5	-0.13	lbf		
A22*R6	-1.19	lbf		

17

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:05 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.46	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.74	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:06 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.0	psig		
A 8*Pressure 2	75.2	psig		
A15*Press1	61.8	psig		
A16*Press2	75.9	psig		
A17*R1	17.18	lbf		
A18*R2	-8.42	lbf		
A19*R3	27.73	lbf		
A20*R4	-1.95	lbf		
A21*R5	-2.22	lbf		
A22*R6	-3.12	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:07 - 00-Jan-72

27

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.46	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:07 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.0	psig		
A 8*Pressure 2	74.9	psig		
A15*Press1	61.9	psig		
A16*Press2	75.9	psig		
A17*R1	17.22	lbf		
A18*R2	-8.33	lbf		
A19*R3	27.74	lbf		
A20*R4	-2.09	lbf		
A21*R5	-2.20	lbf		
A22*R6	-3.11	lbf		

37

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:08 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.36	lbf		
A19*R3	23.77	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:08 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	60.9	psig		
A 8*Pressure 2	75.0	psig		
A15*Press1	61.6	psig		
A16*Press2	75.7	psig		
A17*R1	17.17	lbf		
A18*R2	-8.36	lbf		
A19*R3	27.74	lbf		
A20*R4	-2.08	lbf		
A21*R5	-2.19	lbf		
A22*R6	-3.09	lbf		

H J

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:09

- 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.2	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.2	psig		
A16*Press2	-2.8	psig		
A17*R1	12.46	lbf		
A18*R2	-12.34	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.08	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:09 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	62.0	psig		
A 8*Pressure 2	76.3	psig		
A15*Press1	61.8	psig		
A16*Press2	76.0	psig		
A17*R1	17.19	lbf		
A18*R2	-8.33	lbf		
A19*R3	27.70	lbf		
A20*R4	-2.14	lbf		
A21*R5	-2.20	lbf		
A22*R6	-3.11	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:10 - 00-Jan-72

S V

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.45	lbf		
A18*R2	-12.34	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.09	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:10 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.7	psig		
A 8*Pressure 2	75.8	psig		
A15*Press1	61.5	psig		
A16*Press2	75.8	psig		
A17*R1	17.19	lbf		
A18*R2	-8.27	lbf		
A19*R3	27.67	lbf		
A20*R4	-2.18	lbf		
A21*R5	-2.19	lbf		
A22*R6	-3.09	lbf		

6 ✓

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:11 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.45	lbf		
A18*R2	-12.33	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.87	lbf		
A21*R5	2.09	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:11 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.4	psig		
A 8*Pressure 2	75.6	psig		
A15*Press1	61.7	psig		
A16*Press2	75.8	psig		
A17*R1	17.17	lbf		
A18*R2	-8.46	lbf		
A19*R3	27.81	lbf		
A20*R4	-1.90	lbf		
A21*R5	-2.19	lbf		
A22*R6	-3.09	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:12 - 7 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.44	lbf		
A18*R2	-12.34	lbf		
A19*R3	23.72	lbf		
A20*R4	-1.81	lbf		
A21*R5	2.09	lbf		
A22*R6	0.68	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:13 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.7	psig		
A 8*Pressure 2	76.7	psig		
A15*Press1	61.6	psig		
A16*Press2	76.0	psig		
A17*R1	17.21	lbf		
A18*R2	-8.41	lbf		
A19*R3	27.80	lbf		
A20*R4	-2.00	lbf		
A21*R5	-2.19	lbf		
A22*R6	-3.09	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:14 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.47	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.78	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.09	lbf		
A22*R6	0.67	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:15 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	61.8	psig		
A 8*Pressure 2	76.0	psig		
A15*Press1	61.7	psig		
A16*Press2	75.9	psig		
A17*R1	17.17	lbf		
A18*R2	-8.45	lbf		
A19*R3	27.84	lbf		
A20*R4	-2.03	lbf		
A21*R5	-2.21	lbf		
A22*R6	-3.10	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:15 - 9 Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.45	lbf		
A18*R2	-12.35	lbf		
A19*R3	23.75	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.09	lbf		
A22*R6	0.68	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:16 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
--------	-------	------	-------	----------

A 7*Pressure 1	61.8	psig		
A 8*Pressure 2	76.0	psig		
A15*Press1	61.7	psig		
A16*Press2	75.9	psig		
A17*R1	17.17	lbf		
A18*R2	-8.38	lbf		
A19*R3	27.72	lbf		
A20*R4	-2.02	lbf		
A21*R5	-2.20	lbf		
A22*R6	-3.11	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:16

10-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-1.3	psig		
A 8*Pressure 2	-2.8	psig		
A15*Press1	-1.3	psig		
A16*Press2	-2.8	psig		
A17*R1	12.44	lbf		
A18*R2	-12.37	lbf		
A19*R3	23.76	lbf		
A20*R4	-1.86	lbf		
A21*R5	2.09	lbf		
A22*R6	0.68	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:17 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.5	psig		
A 8*Pressure 2	76.0	psig		
A15*Press1	61.6	psig		
A16*Press2	75.9	psig		
A17*R1	17.14	lbf		
A18*R2	-8.36	lbf		
A19*R3	27.75	lbf		
A20*R4	-2.11	lbf		
A21*R5	-2.18	lbf		
A22*R6	-3.08	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:17 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	61.0	psig		
A 8*Pressure 2	75.8	psig		
A15*Press1	61.6	psig		
A16*Press2	76.0	psig		
A17*R1	17.15	lbf		
A18*R2	-8.36	lbf		
A19*R3	27.74	lbf		
A20*R4	-2.08	lbf		
A21*R5	-2.19	lbf		
A22*R6	-3.07	lbf		

\*\*\*\*\* REPEAT STRAIGHT, 1/24/91

\*\*\*\*\* Record 01:18 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	71.4	psig		
A 8*Pressure 2	88.0	psig		
A15*Press1	70.6	psig		
A16*Press2	86.7	psig		
A17*R1	17.79	lbf		
A18*R2	-7.89	lbf		
A19*R3	28.27	lbf		
A20*R4	-2.15	lbf		
A21*R5	-2.80	lbf		
A22*R6	-3.67	lbf		

**Measured Thrust of Vectored Nozzles**

by

**Gregory Devlin**

Mechanical Engineering Department  
California Polytechnic State University

San Luis Obispo

August 26, 1991

## TABLE OF CONTENTS

Abstract .....	1
Objectives.....	2
Introduction .....	3
Discussion.....	5
Reduction of Twist (Mz).....	5
Reduction of Bending (Mx & My).....	8
Dead Weight Test .....	10
New Plenum Test.....	15
Application of Calibration Curves.....	19
Calibration Equations .....	19
Reactions.....	20
Forces and Moments.....	28
Repeatability of Test Stand (Statistical Analysis) .....	40
Procedure Listing.....	42
Conclusions.....	43
References.....	44
Appendices.....	45
Appendix A - 12/19/90 Straight Nozzle Run.....	45
Appendix B - 5/24/91 Straight Nozzle Run .....	58
Appendix C - 8/8/91 Dead Weight Test .....	73
Appendix D - 8/8/91 Plug Nozzle Run .....	75
Appendix E - 8/8/91 Straight Nozzle Run.....	100
Appendix F - 8/8/91 Straight Nozzle Run (Plenum Rev.)....	125
Appendix G - 8/15/91 Plug Nozzle Run.....	136
Appendix H - 8/15/91 Straight Nozzle Run.....	157
Appendix I - 8/15/91 Statistical Data and Calculations .....	181

## LIST OF TABLES

Table 1 Dead Weight Test Results .....	10
Table 2 Summary of Statistical Calculations.....	41
Table 3 Appendix I - Statistical Calculations.....	182

## LIST OF FIGURES

Figure 1 Thrust Stand Coordinate System .....	3
Figure 2 December 19, 1990 15 Degree Nozzle-Mz.....	6
Figure 3 May 24, 1991 15 Degree Nozzle-Mz .....	7
Figure 4 August 8, 1991 Comparison of Vertical Reactions.....	7
Figure 5 August 8, 1991 " Plenum Reversed .....	12
Figure 6 August 8, 1991 Straight Nozzle-Mx.....	13
Figure 7 August 8, 1991 Straight Nozzle-My.....	14
Figure 8 August 15, 1991 Comparison of Vertical Reactions.....	16
Figure 9 August 15, 1991 Straight Nozzle-Mx .....	17
Figure 10 August 15, 1991 Straight Nozzle-My .....	18
Figure 11 August 15, 1991 Plug Nozzle-R1 .....	20
Figure 12 August 15, 1991 Plug Nozzle-R2 .....	21
Figure 13 August 15, 1991 Plug Nozzle-R3 .....	22
Figure 14 August 15, 1991 Plug Nozzle-R4 .....	23
Figure 15 August 15, 1991 Plug Nozzle-R5 .....	24
Figure 16 August 15, 1991 Plug Nozzle-R6 .....	25
Figure 17 August 15, 1991 Comp. of Vert.Reactions w/Cal.....	26
Figure 18 August 15, 1991 Straight Nozzle Calibrated-R1 .....	28
Figure 19 August 15, 1991 Straight Nozzle Calibrated-R2 .....	29
Figure 20 August 15, 1991 Straight Nozzle Calibrated-R3 .....	30
Figure 21 August 15, 1991 Straight Nozzle Calibrated-R4 .....	31
Figure 22 August 15, 1991 Straight Nozzle Calibrated-R5 .....	32
Figure 23 August 15, 1991 Straight Nozzle Calibrated-R6 .....	33
Figure 24 August 15, 1991 Straight Nozzle Calibrated-Fx.....	34
Figure 25 August 15, 1991 Straight Nozzle Calibrated-Fy.....	35
Figure 26 August 15, 1991 Straight Nozzle Calibrated-Fz.....	36
Figure 27 August 15, 1991 Straight Nozzle Calibrated-Mx.....	37
Figure 28 August 15, 1991 Straight Nozzle Calibrated-My .....	38
Figure 29 August 15, 1991 Straight Nozzle Calibrated-Mz.....	39

## ABSTRACT

This project compared the forces and moments produced by straight and 15 degree vectored nozzles using the six component thrust stand in the engines lab at Cal Poly. As a result of these comparisons, some unexpected forces and moments were discovered, which were due to the line pressure effects of the system. These reactions are undesirable as they do not directly result from the nozzle thrust, and therefore need be minimized. Several revisions were made to the thrust stand, which included a new table, stronger brackets, and a more accurately assembled plenum chamber. Along with these revisions, a new computer program was written to take data from the plug (zero thrust) nozzle, find the calibration curves, and apply this information to the thrust nozzle runs. This resulted in a significant improvement to the accuracy of the thrust stand.

## OBJECTIVES

The objectives of this Senior Project are as follows:

- To minimize line pressure effects of the system.
- To evaluate the test runs of 12/19 and 5/24 to determine if the new table and brackets eliminate the moments in the Z direction (twist).
- To evaluate the test runs of 8/8 and 8/15 to determine if the plenum chamber unbalance was the cause of the moments in the X and Y directions (bend).
- To determine the calibration equations of the system (8/15 data)
- To develop a computer program that would calibrate thrust data by use of the plug nozzle data (zero thrust).
- To evaluate the statistical repeatability of the data acquisition system.
- To outline the procedure for data retrieval and analysis using the Fluke data acquisition system and Apple Macintosh computer.

## INTRODUCTION

Future aircraft with the capability of short takeoff and landing, and improved maneuverability especially in the post-stall flight regime will incorporate exhaust nozzles which can be thrust vectored.

The Thrust Vectoring Research Project at California Polytechnic State University began in 1989 in order to evaluate thrust vectored nozzles using a multi-component thrust test stand sponsored by NASA. The stand is comprised of an air supply of 120 psig (maximum) with a supply valve, a table with a series of brackets and bellows, a dual inlet plenum chamber, and nozzle mount tube with various exhaust nozzles. The system exists in three dimensional space having six degrees of freedom, and therefore required six load cells to have a determinate solution (three in the vertical direction, three in the horizontal direction). The configuration of the load cells and coordinate system can be seen in Figure One.

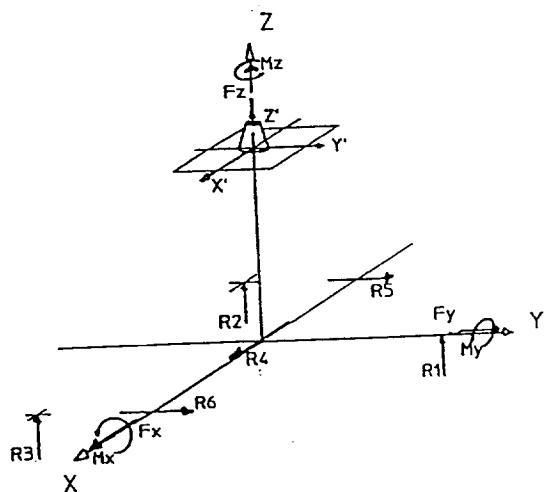


Figure 1: The thrust stand coordinate system

The data recording is provided by a FLUKE data acquisition computer. The FLUKE is connected to all six load cells and the two pressure transducers. The computer monitors all eight channels and displays the information on a screen or can print a hard copy to the printer. Before each pressurized run, a zero pressure or 'tare' reading is recorded as the transducers do not rest with zero voltage. These six load cell reactions are then transferred to a Microsoft Excel spreadsheet which calculates the forces and moments of the system. The following equations are used in the computation of the reactions:

$$F_x = R_4 \quad (1)$$

$$F_y = R_5 + R_6 \quad (2)$$

$$F_z = R_1 + R_2 + R_3 \quad (3)$$

$$M_x = R_1 * Y_1 + R_2 * Y_2 + R_3 * Y_3 \quad (4)$$

$$M_y = R_2 * X_2 - R_3 * X_3 \quad (5)$$

$$M_z = R_5 * X_5 + R_6 * X_6 \quad (6)$$

This data, now in table form, may be copied over to the graphics program "Cricket Graph", in order to generate any plots required.

## DISCUSSION

### A. Reduction of Twist (Mz)

It was evident that there was a great problem with twist in the system as shown in the December 19 test runs. Theoretically, the 15 degree nozzle should produce a moment around the X or Y axis (or both if not at a 90 degree increment), but no moment around the Z axis should exist. However, a moment of approximately 19 in-lb resulted from the 15 degree nozzle at 80 psi on December 19. (See Figure 2) It was theorized that this was caused by twisting of the air supply line, so a new, stronger table was constructed that also consisted of sturdy blocks and improved bellows. A new brace was added that spanned from block to block which further increased the rigidity of the system. Care had to be taken though, to keep the test stand somewhat flexible in the Z direction, as low vertical resistance was needed for accurate measurement of thrust from the load cells. With these new additions to the test stand, a run was taken on May 24 with the 15 degree nozzle. The moment in the Z direction was greatly reduced to only 3 in-lb at 80 psi (See Figure 3). Dr. Carpenter believes that this may be reduced even further with the use of externally pressurized bellows.

**Comparison of Moments in the Z direction  
12/19/90 - 15 Degree Nozzle**

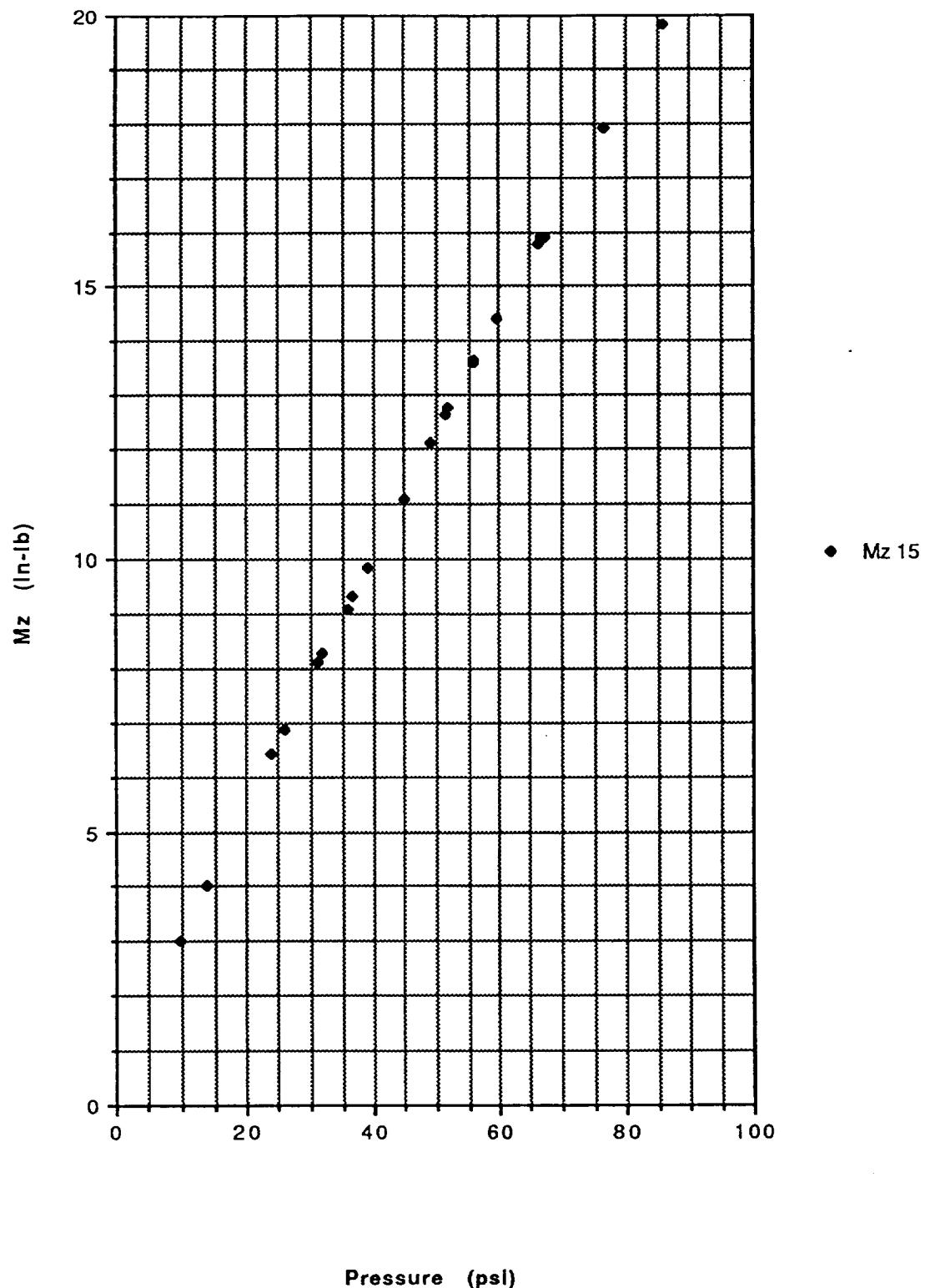


Figure 2

Comparison of Moments in Z Direction  
5/24/91 - 15 Degree Nozzle  
Brackets Installed

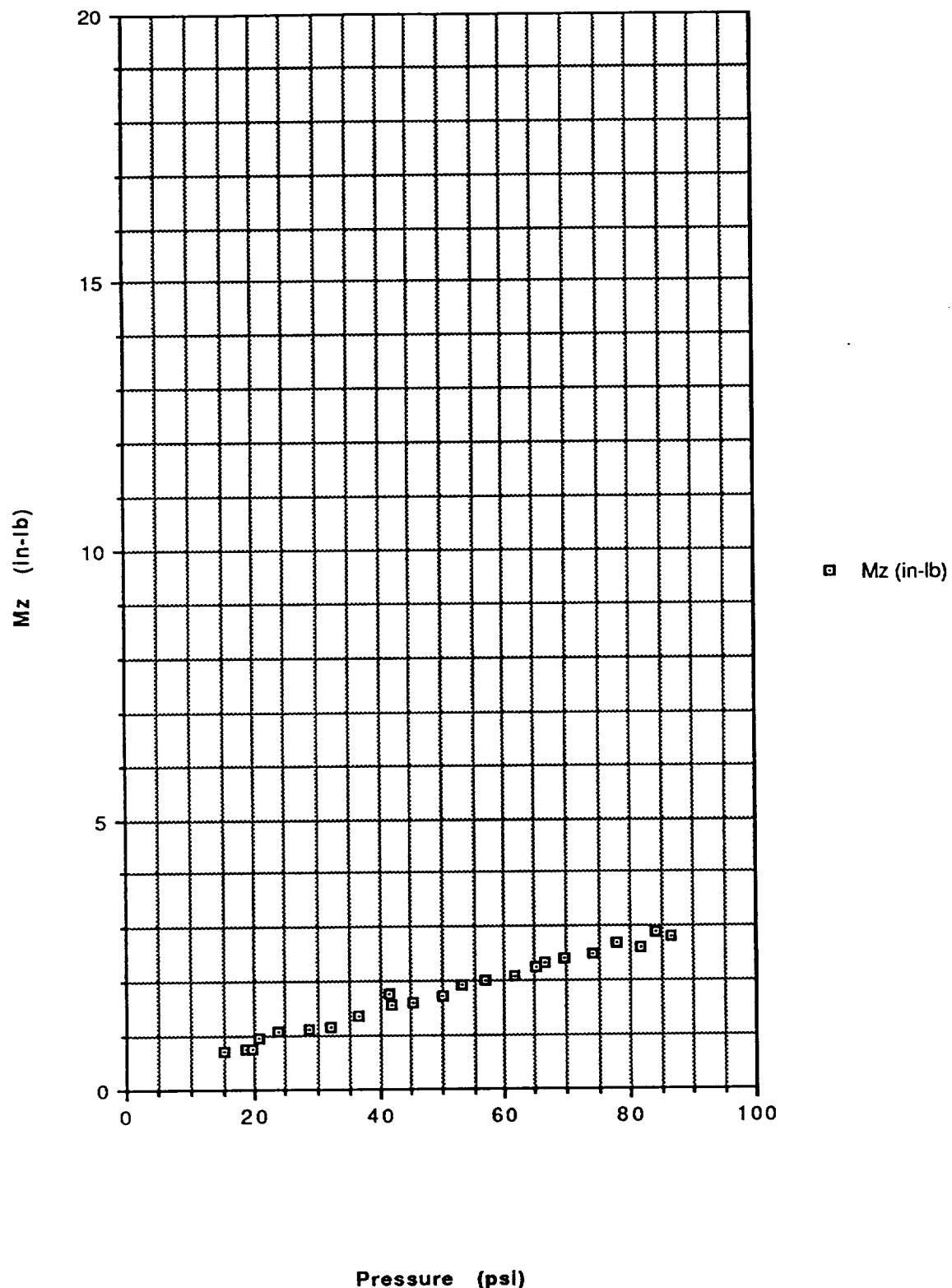


Figure 3

### B. Reduction of Bending (M<sub>x</sub> & M<sub>y</sub>)

The test runs of May 24 revealed that there was a significant problem with bending in the system. Theoretically, the straight nozzle should produce only a force in the Z direction (thrust), and no other forces or moments. The forces in the X, Y, and Z direction were -0.5, -1.0, and 16 lbf. respectively at 80 psi. However, a moment existed in the Y direction equal to -25 in-lb at 80 psi. In order to investigate the nature of this bending, the equations in which the moment is calculated must be examined (Equation 5).

$$M_y = R_2 \cdot X_2 - R_3 \cdot X_3 \quad (5)$$

Since X<sub>2</sub> and X<sub>3</sub> are constants equal to each other (4.33 in.), it is our goal to make R<sub>2</sub> and R<sub>3</sub> equal each other in order to eliminate M<sub>y</sub>. We may gain further information by looking at M<sub>x</sub> (Equation 4).

$$M_x = R_1 \cdot Y_1 + R_2 \cdot Y_2 + R_3 \cdot Y_3 \quad (4)$$

Again, with Y<sub>1</sub>=5 in., Y<sub>2</sub>=Y<sub>3</sub>=-2.5 in., the reactions need be equal to eliminate the moment in the X direction. Since the Force in the Z direction (thrust) is equal to the sum of R<sub>1</sub>, R<sub>2</sub>, and R<sub>3</sub>, the goal was not to reduce the reactions, but make them equal.

The tests runs of August 8 were performed to investigate the unbalance of these three load cells. The most obvious explanation to this unbalance would be that the nozzle was not centered on the pedestal, therefore causing more force to be applied to a particular load cell. To test this theory, a dead weight test (a lead weight balanced on top of the nozzle) was performed on the morning of August 8th. The results of this test are summarized in Table One.

**Comparison of Vertical Reactions  
8/8/91 Straight Nozzle  
Plenum in Original Configuration**

9

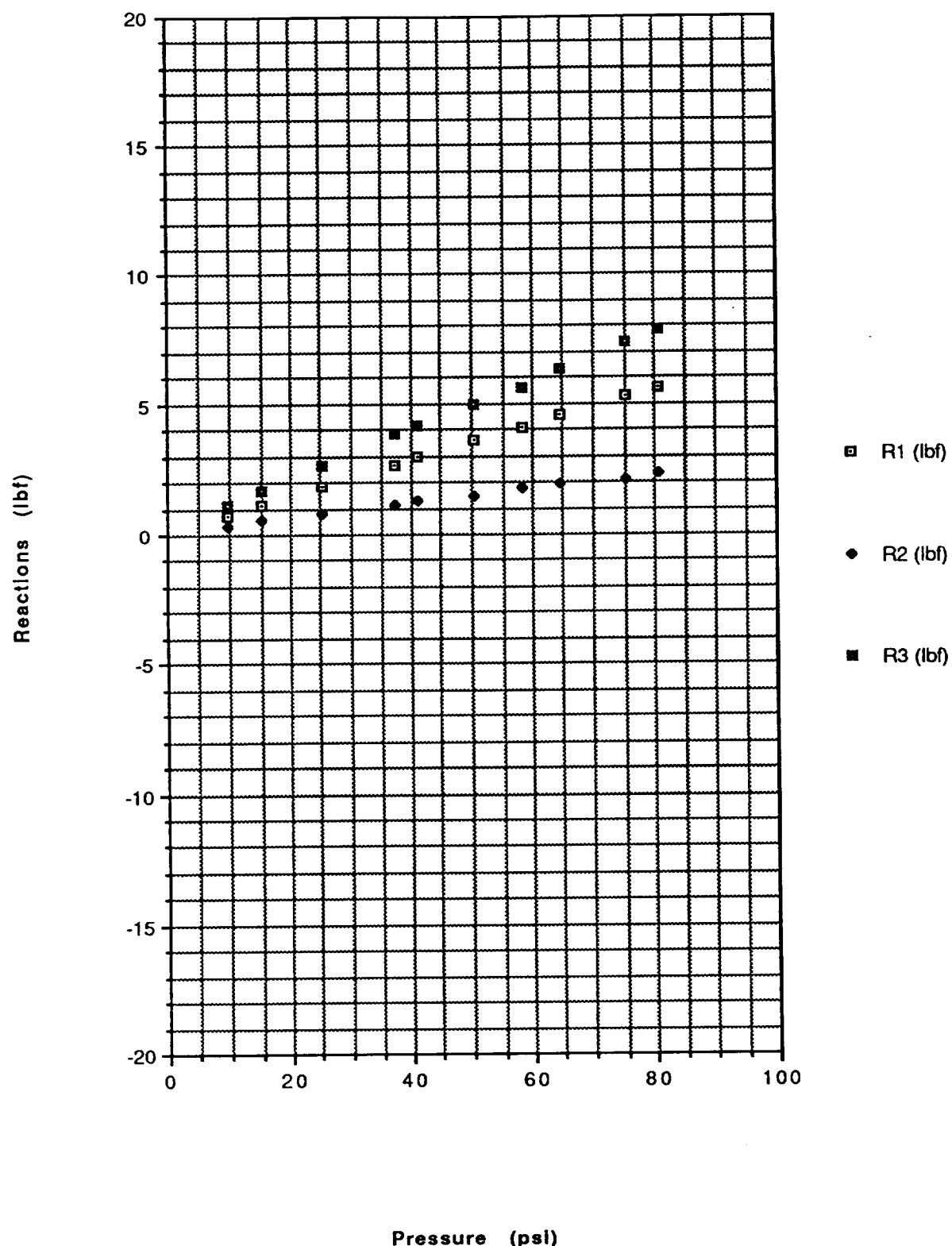


Figure 4

TABLE ONE  
DEAD WEIGHT TEST RESULTS

Weight = 1680.5 g = 3.70 lbf

R1=1.22 lbf

R2=1.21 lbf

R3=1.23 lbf

Wt=3.66 lbf

It is evident that the nozzle is centered and balanced on the pedestal, since R1=R2=R3 (within 0.01 lbf). As expected, R4=R5=R6=0 for the dead weight run. The unbalance of vertical reactions during pressurized runs was believed to be caused by some dynamic unbalance of the system.

The Plug nozzle was run next (zero thrust), followed by the straight nozzle. It was observed that the vertical reactions varied from 2 lbf. to 8 lbf. at 80 psi (See Figure 4).

The following are approximate values at 80 psi:

R1=5.5 lbf

R2=2.0 lbf

R3=8.0 lbf

In physical terms, the above numbers would result in the pedestal "leaning" to the left (if looking from location R1), which results in a large negative moment around the Y axis, equal to -24 in-lbf at 80 psi.

It was theorized that this bending was occurring from pressure effects inside the air plenum. One of the inlets to the plenum was welded on at a slightly skewed angle, and this small unbalance could cause great errors at high pressures. To test this theory, the plenum chamber was reversed (180 degrees) and a new series of straight nozzle tests were ran. The results turned out as expected, and can be seen in Figure 5. The approximate values of the reactions at 80 psi are listed below:

$$R1=3.5 \text{ lbf}$$

$$R2=14 \text{ lbf}$$

$$R3=-1.5 \text{ lbf}$$

It can be seen that the bending was so large that it caused one of the load cells to go into tension! This resulted in an extreme bending moment of +60 in-lbf around the Y axis. This led us to believe that the plenum was at fault for this unbalance in the system. A bending moment of -13 in-lbf existed around the X axis at 80 psi (See Figures 6 & 7). These moments were more extreme than the earlier case because when the plenum was reversed, it was not leveled with a scale (which is usually done during installation).

**Comparison of Vertical Reactions**  
**8/8/91 Straight Nozzle**  
**Plenum Reversed**

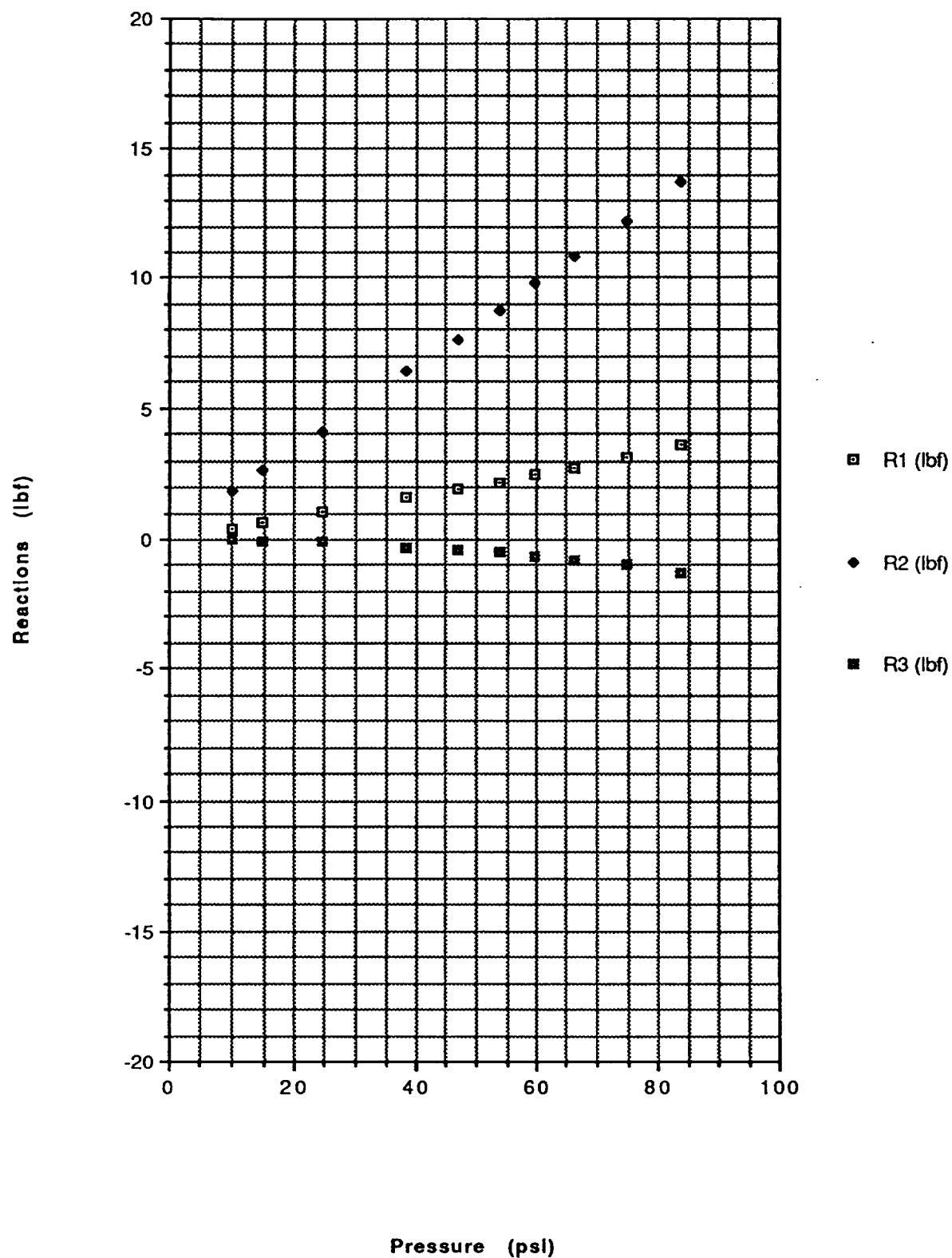


Figure 5

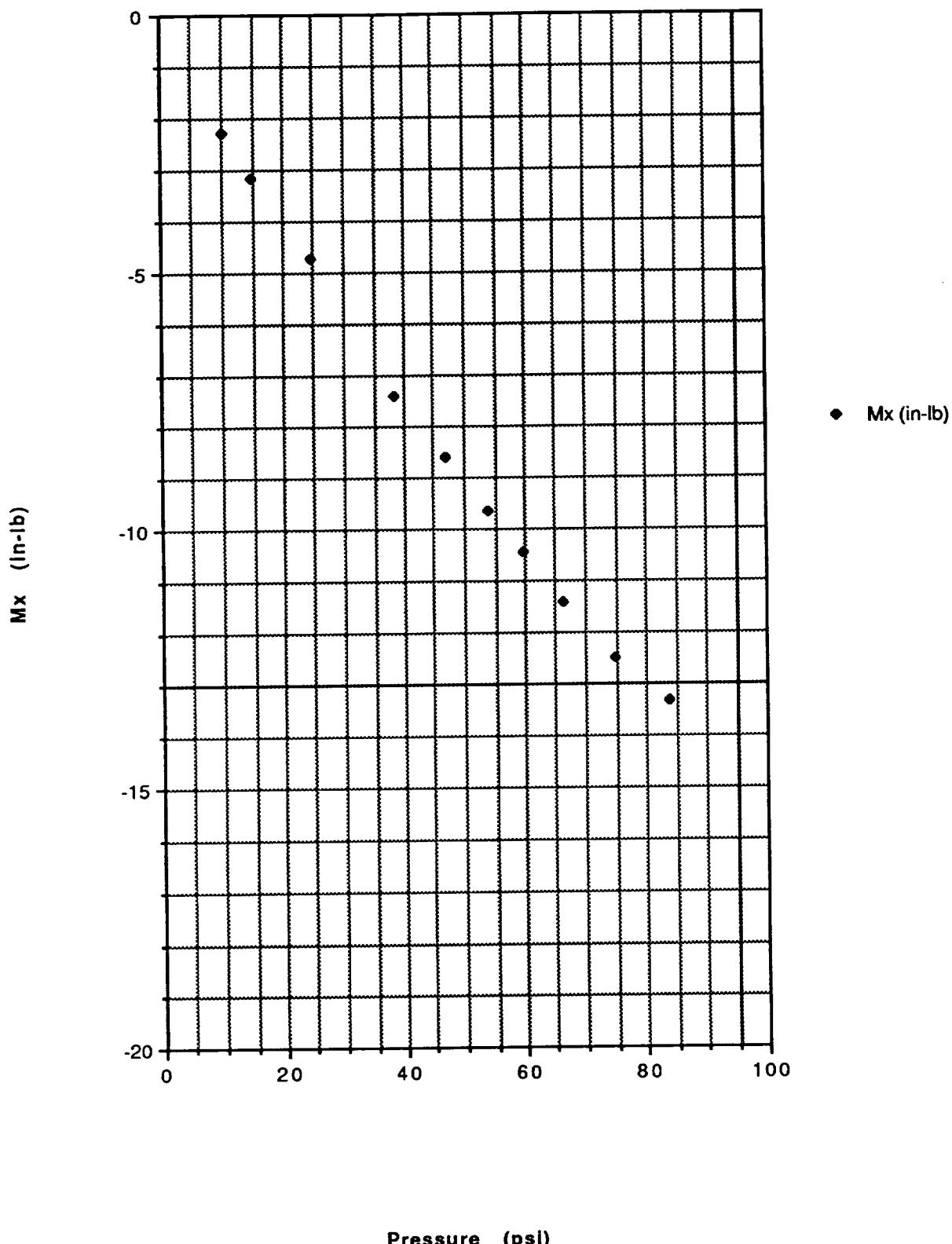
**Data from "8/8/91 Str.P.Rev. CG DATA"**

Figure 6

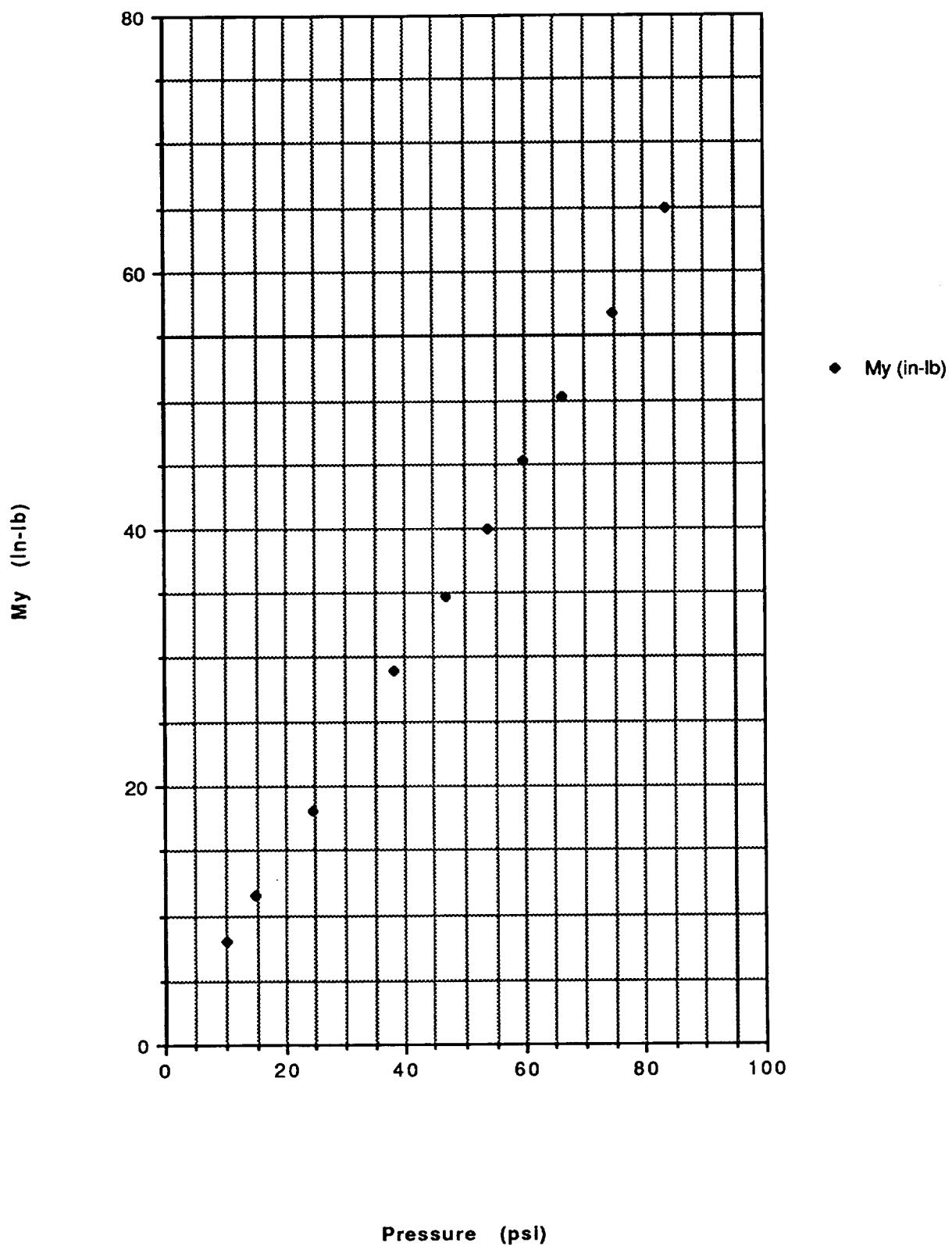
**Data from "8/8/91 Str.P.Rev. CG DATA"**

Figure 7

To alleviate this condition, a new plenum chamber was constructed. The inlet rings were welded while being held in place by a jig, in order to minimize misalignment. The bellows were then balanced with a scale to insure that they were level.

The test runs on August 15 were performed to determine if this new plenum chamber would reduce the bending around the X and Y axes. A Plug nozzle test was ran first, followed by the Straight nozzle test.. The variation of reactions in the vertical plane was greatly reduced (See Figure 8), and the approximate values are listed below at 80 psi:

$$R1=4.5 \text{ lbf}$$

$$R2=6.0 \text{ lbf}$$

$$R3=7.0 \text{ lbf}$$

The bending moment in the X direction was reduced from -13 to -10 in-lbf, and the bending moment in the Y direction was reduced from +60 in-lbf to -3 in-lbf (the axis perpendicular to the plenum chamber inputs). These results can be seen in Figures 9 & 10. The moment in the X direction is still somewhat large because of the difference between R1 & R3. It was noticed, however, that these differences also existed during the Plug nozzle (zero thrust) tests. It was believed that these small differences could be reduced if calibration equations were found during the zero thrust trials and applied to the results of the straight nozzle runs.

Comparison of Vertical Reactions  
8/15/91 Straight Nozzle  
New Plenum

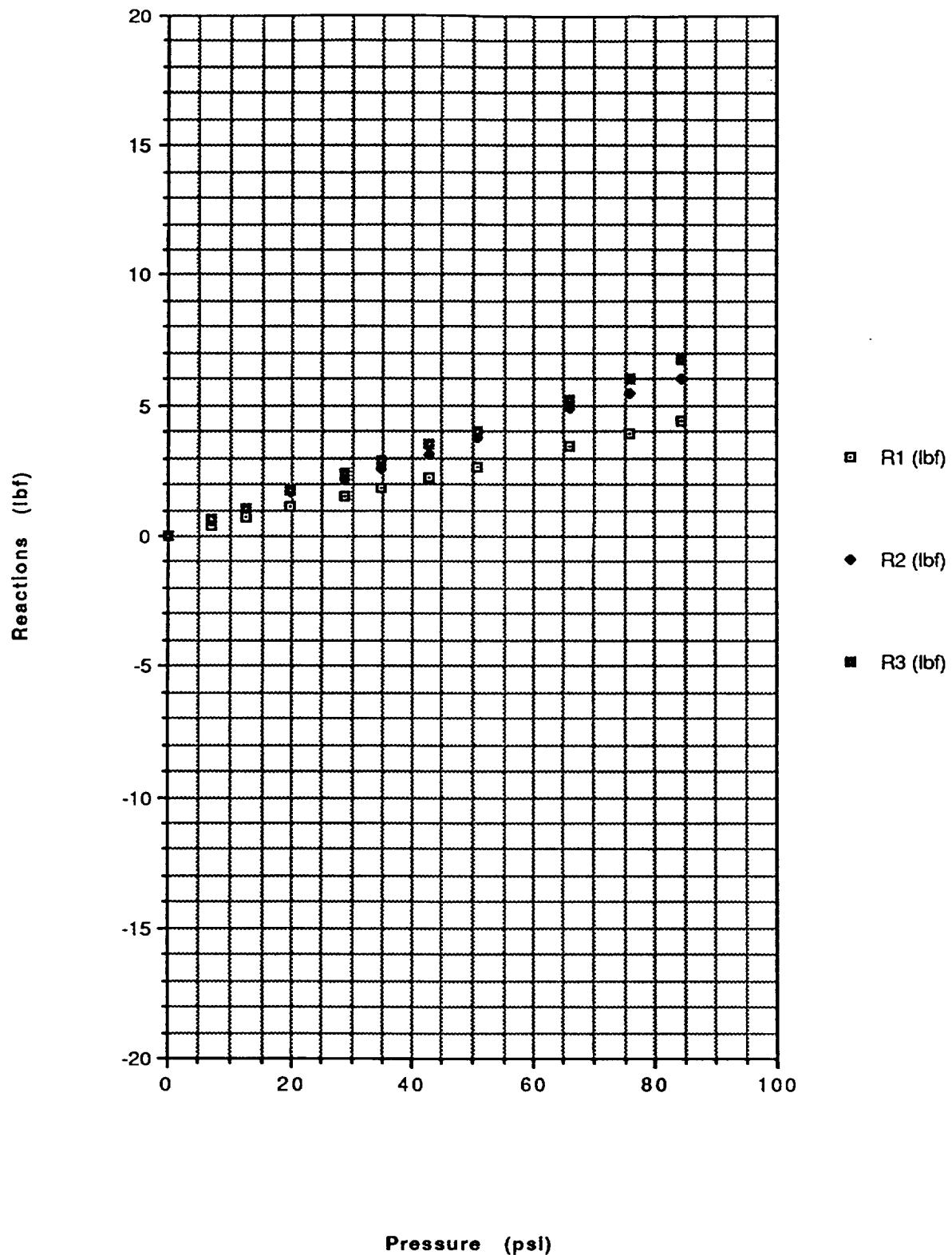


Figure 8

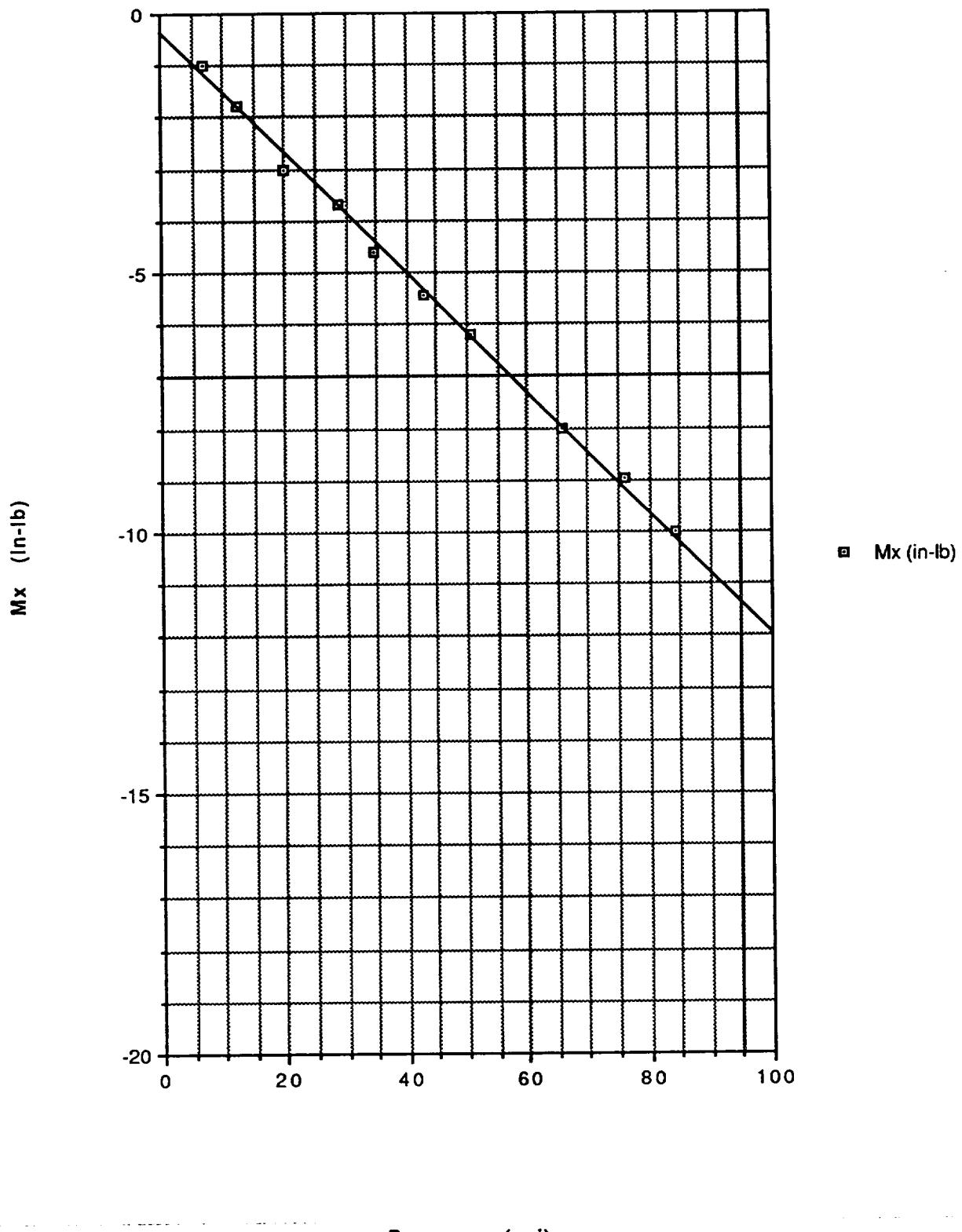
**Data from "8/15/91 Straight Data"**

Figure 9

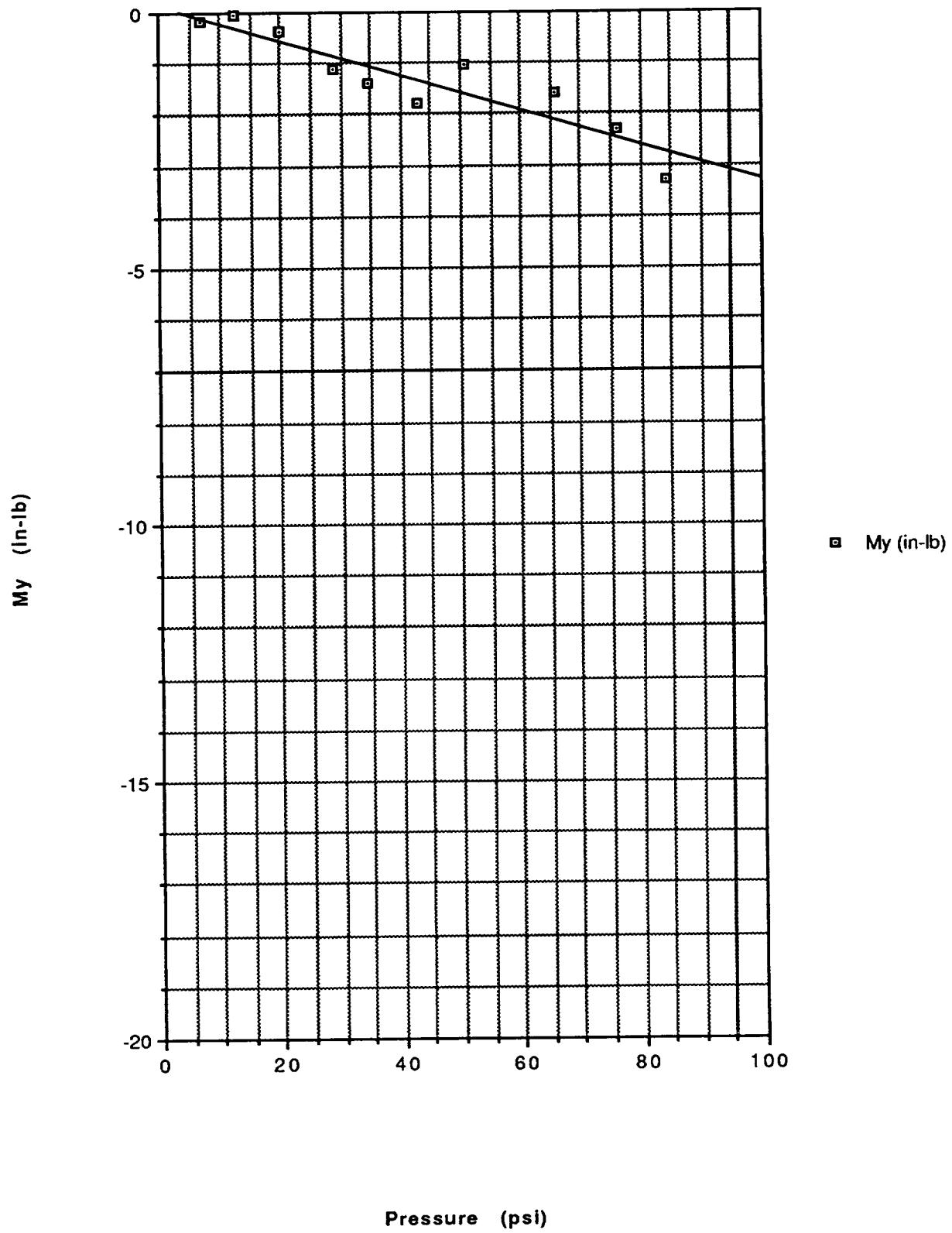
**Data from "8/15/91 Straight Data"**

Figure 10

### C. Application of Calibration Curves

It was believed that if a Plug nozzle trial was run before positive thrust trials, calibration equations could be developed that would compensate for the line pressure effects of the system. If these equations were applied to the positive thrust runs, the line pressure effects would hopefully be reduced to give a true reading of the resulting nozzle thrust. A Plug nozzle test was performed on August 15th that resulted in the following calibration equations:

$$R1: \quad y = -0.063 - 0.012x \quad (7)$$

$$R2: \quad y = 0.029 + 0.003x \quad (8)$$

$$R3: \quad y = -0.016 + 0.009x \quad (9)$$

$$R4: \quad y = -0.032 + 0.004x \quad (10)$$

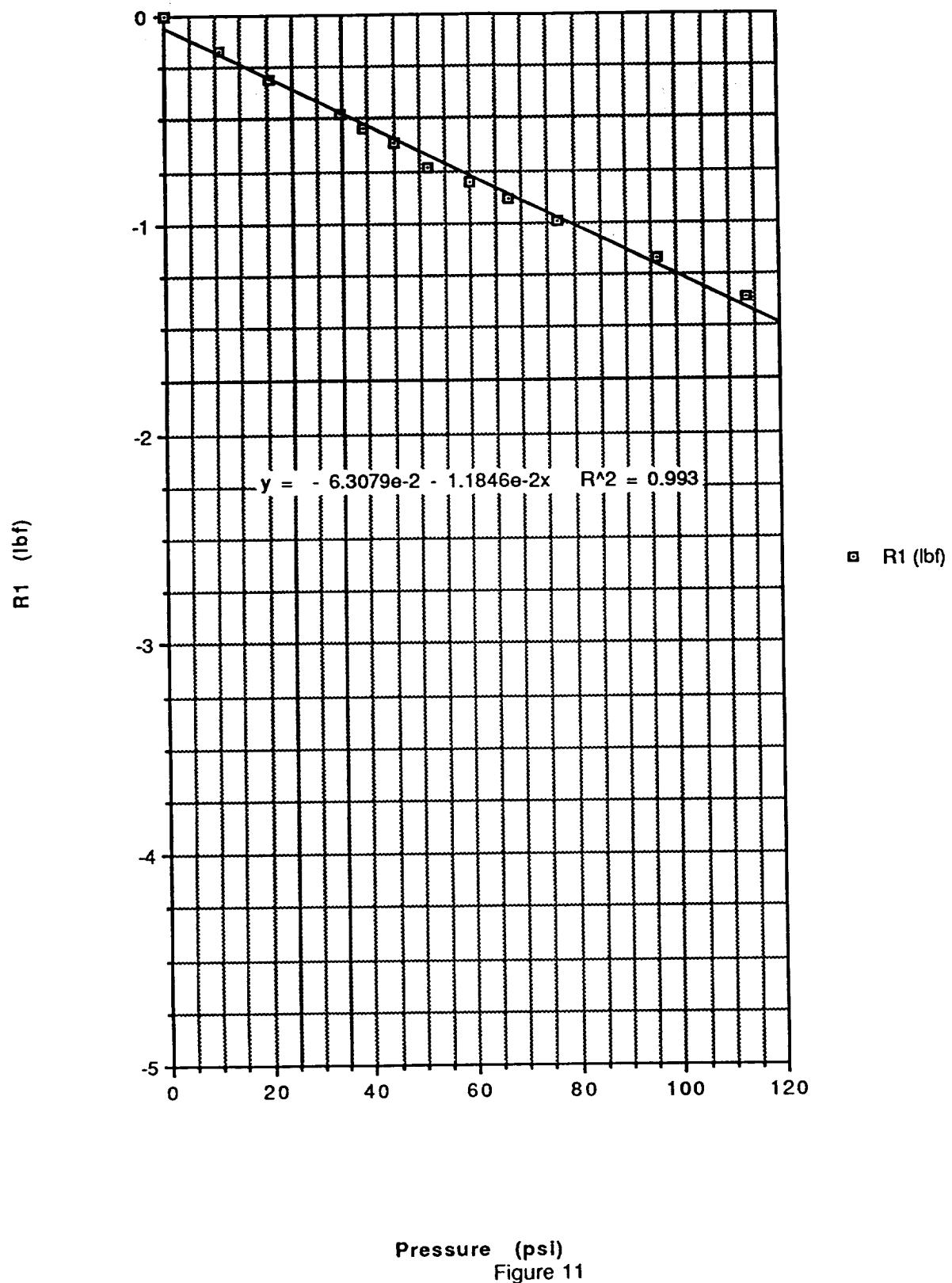
$$R5: \quad y = 0.003 - 0.002x \quad (11)$$

$$R6: \quad y = -0.003 - 0.007 \quad (12)$$

The above equations were derived from the linear regression function on the graphics program "Cricket Graph". The curves can be seen in Figures 11-16. A new Microsoft Excel spreadsheet was written that takes the straight or inclined nozzle data and subtracts the calibration data. This program is labeled "Worksheet Base w/ Cal".

When the calibration curves were applied to the August 15 straight nozzle test run, the spread between R1, R2, and R3 was reduced to under 1 lbf. This can be seen in Figure 17. This resulted in a great reduction of M<sub>x</sub> and M<sub>y</sub>, which were then calculated to be -2 in-lbf and -1 in-lbf respectively at 80 psi. This may be observed in Figures 27 and 28.

## Data from "8/15/91 Plug Data"



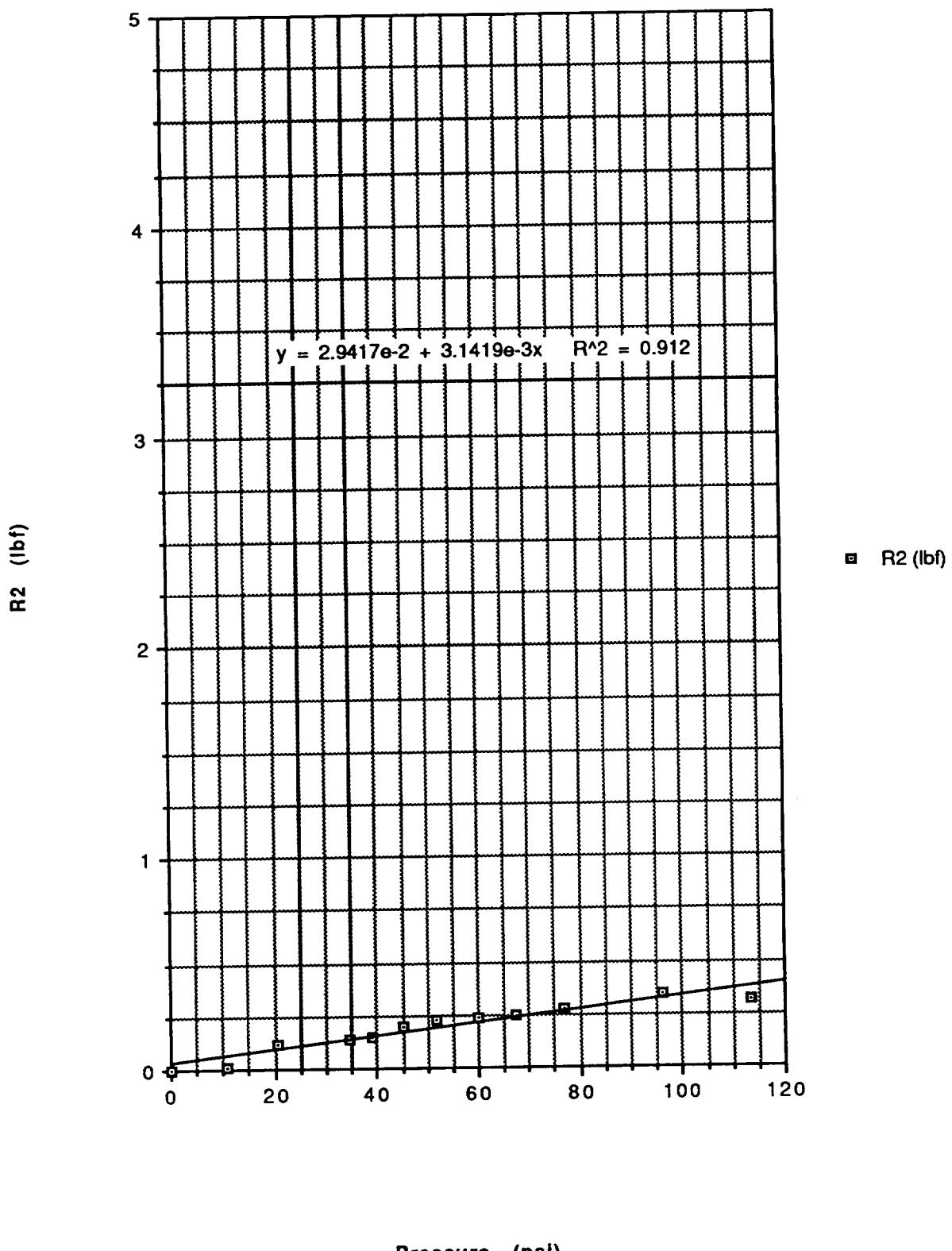
**Data from "8/15/91 Plug Data"**

Figure 12

## Data from "8/15/91 Plug Data"

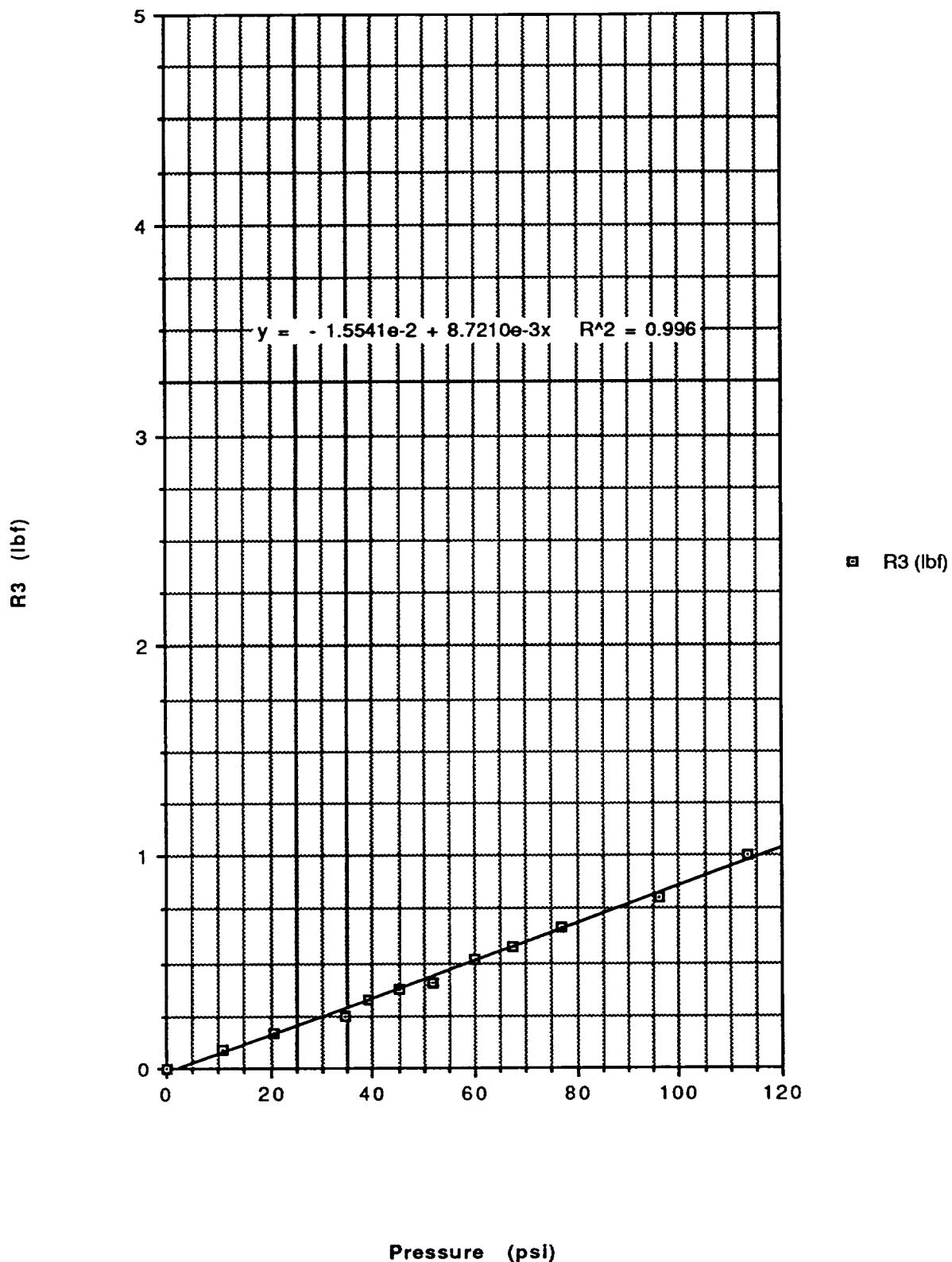


Figure 13

## Data from "8/15/91 Plug Data"

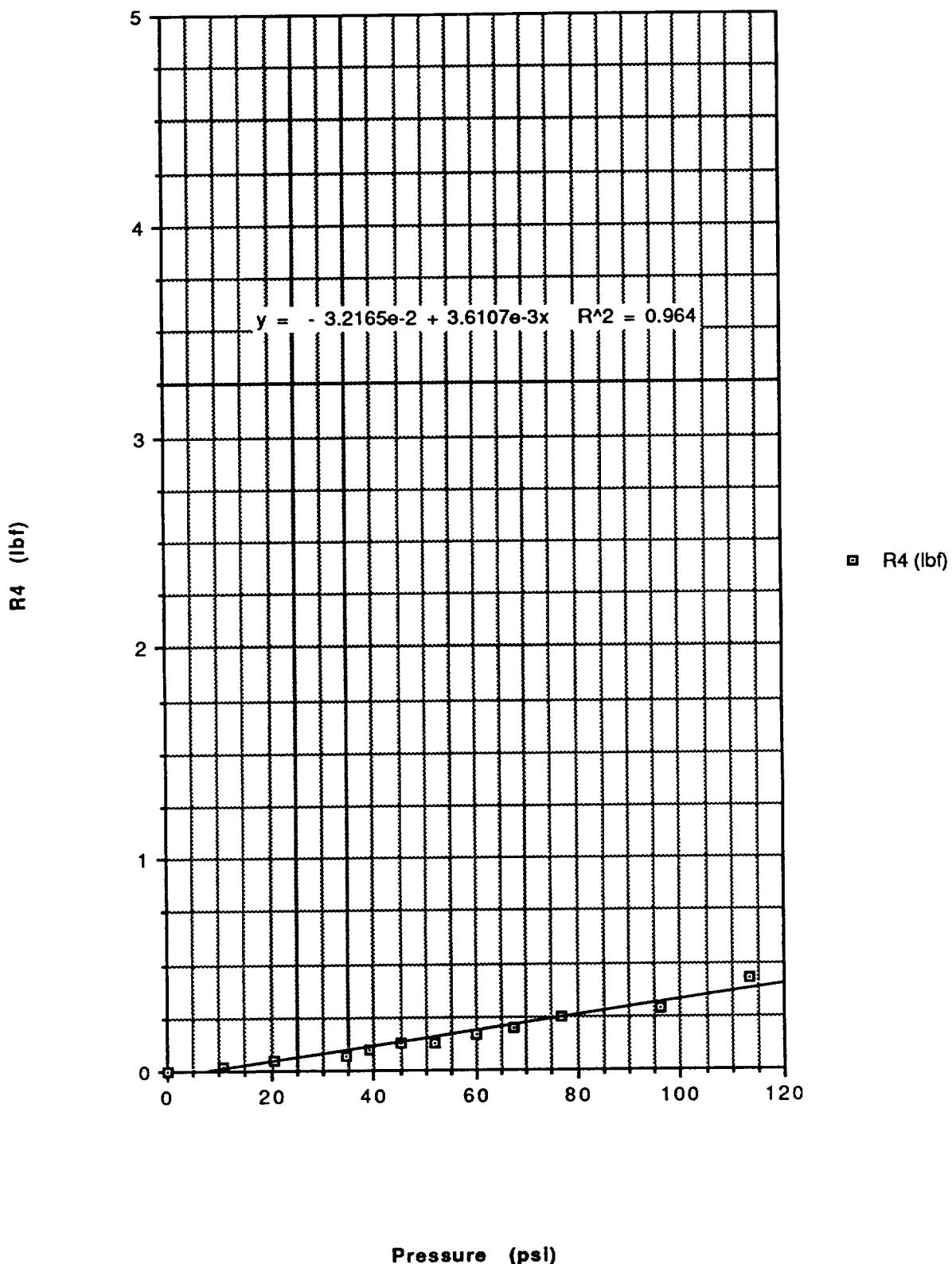


Figure 14

## Data from "8/15/91 Plug Data"

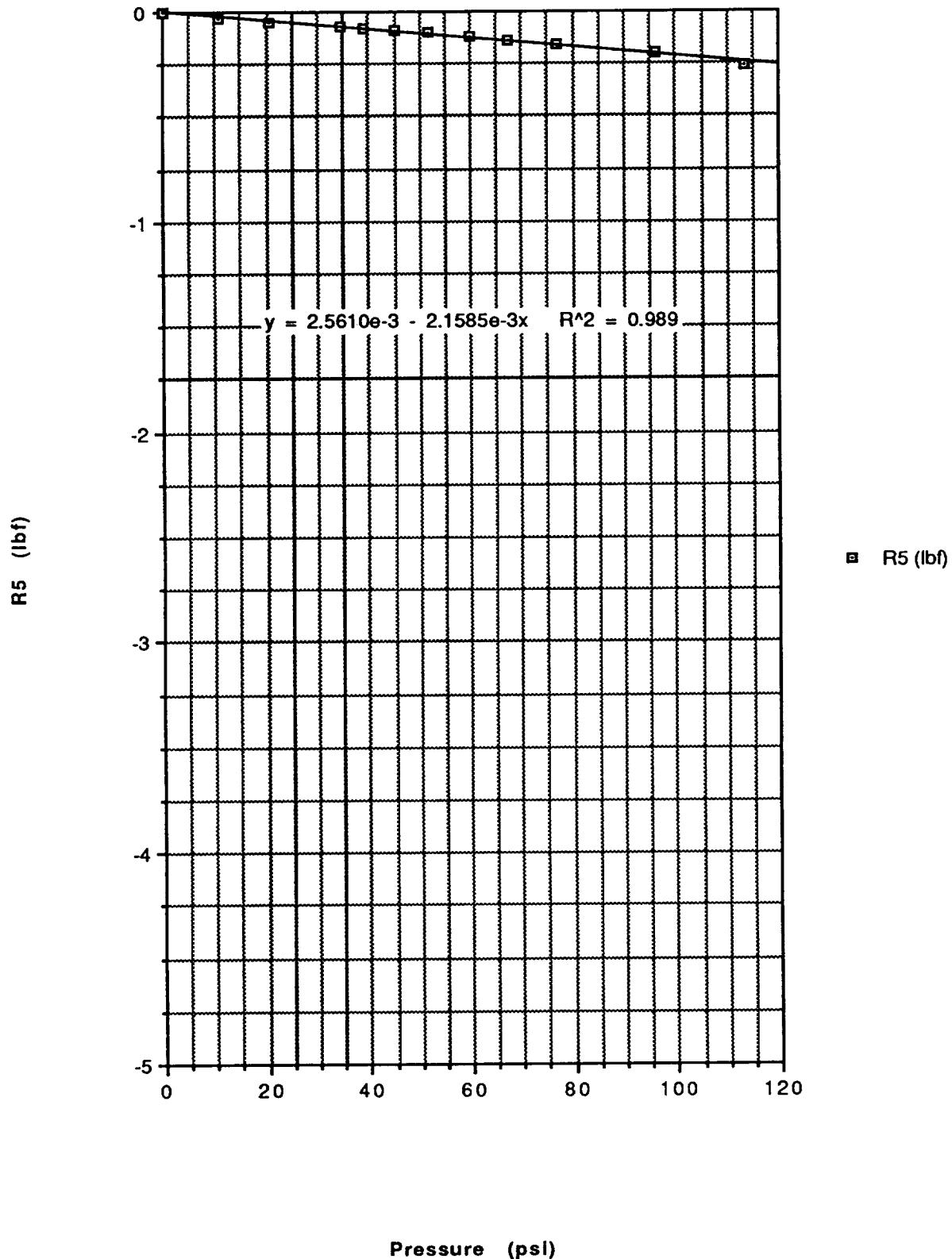


Figure 15

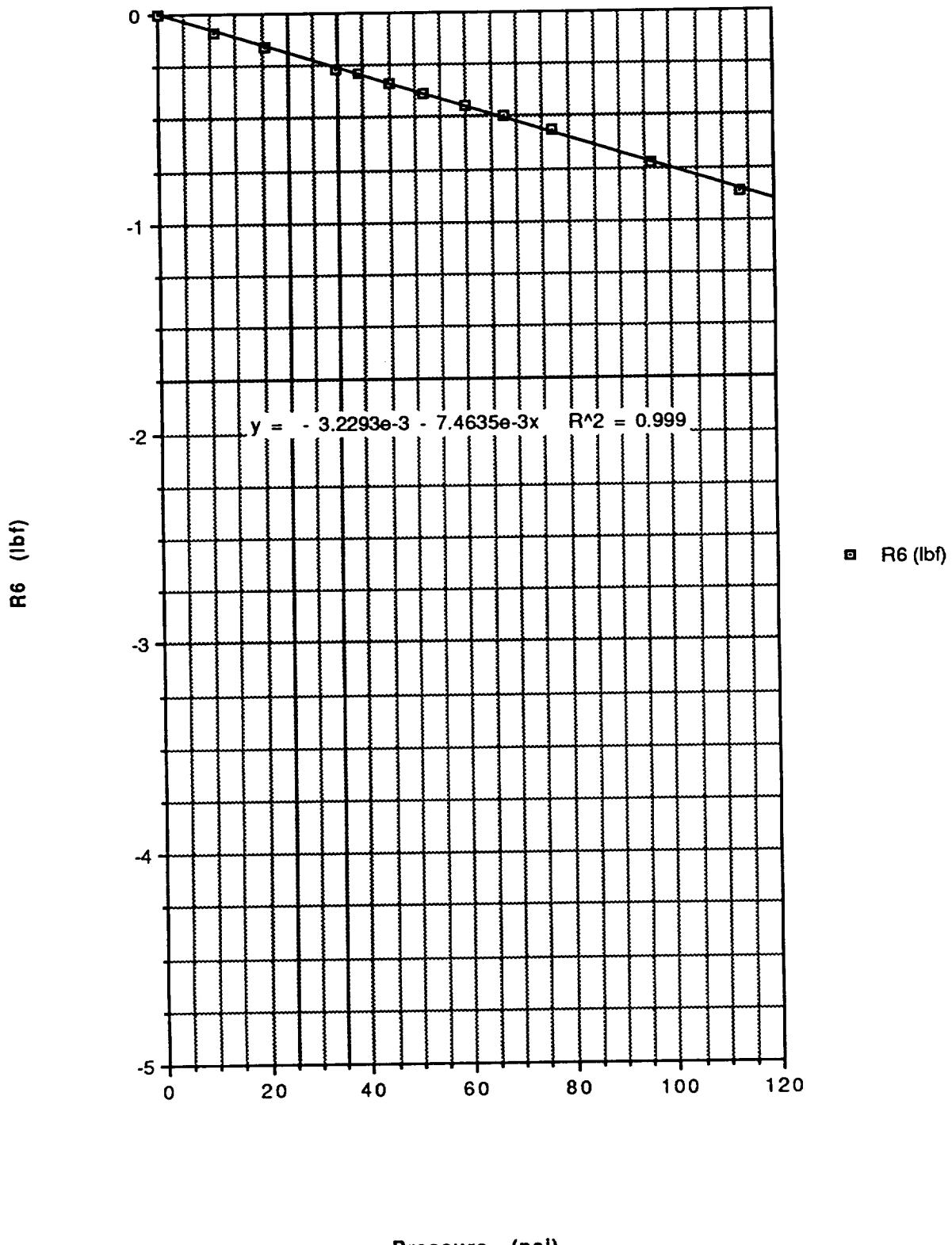
**Data from "8/15/91 Plug Data"**

Figure 16

Comparison of Vertical Reactions  
8/15/91 Straight Nozzle  
New Plenum - Calibration Applied

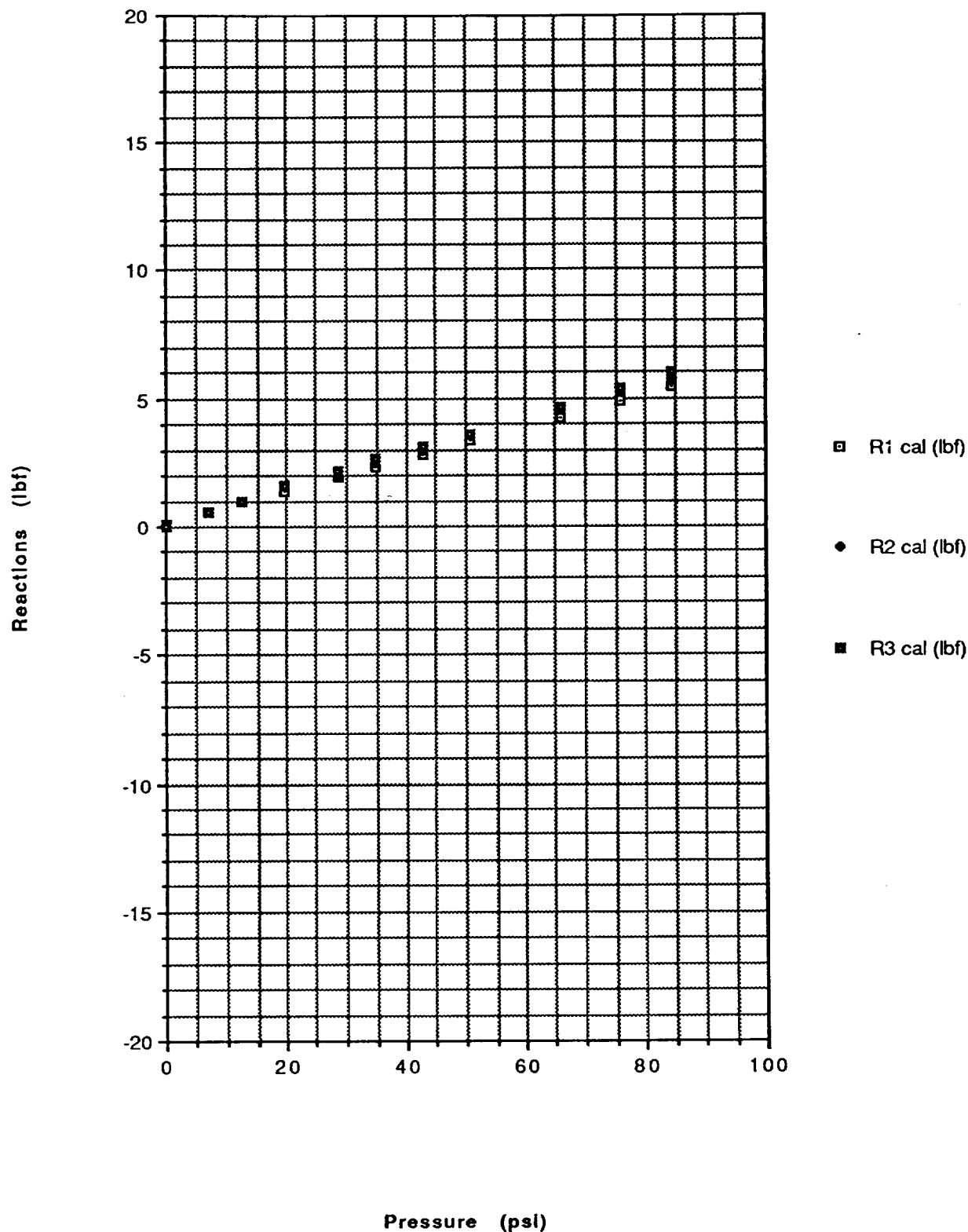


Figure 17

This new calibrated data reduced both the forces in the X and Y directions, and the moments in the X, Y, and Z directions. Even better data can possibly be attained from a more thorough calibration run (since only 10 data points were taken in this run). The following figures describe the calibrated run:

Load Cell Reactions: Figures 18-23

Calculated Forces: Figures 24-26

Calculated Moments: Figures 27-29

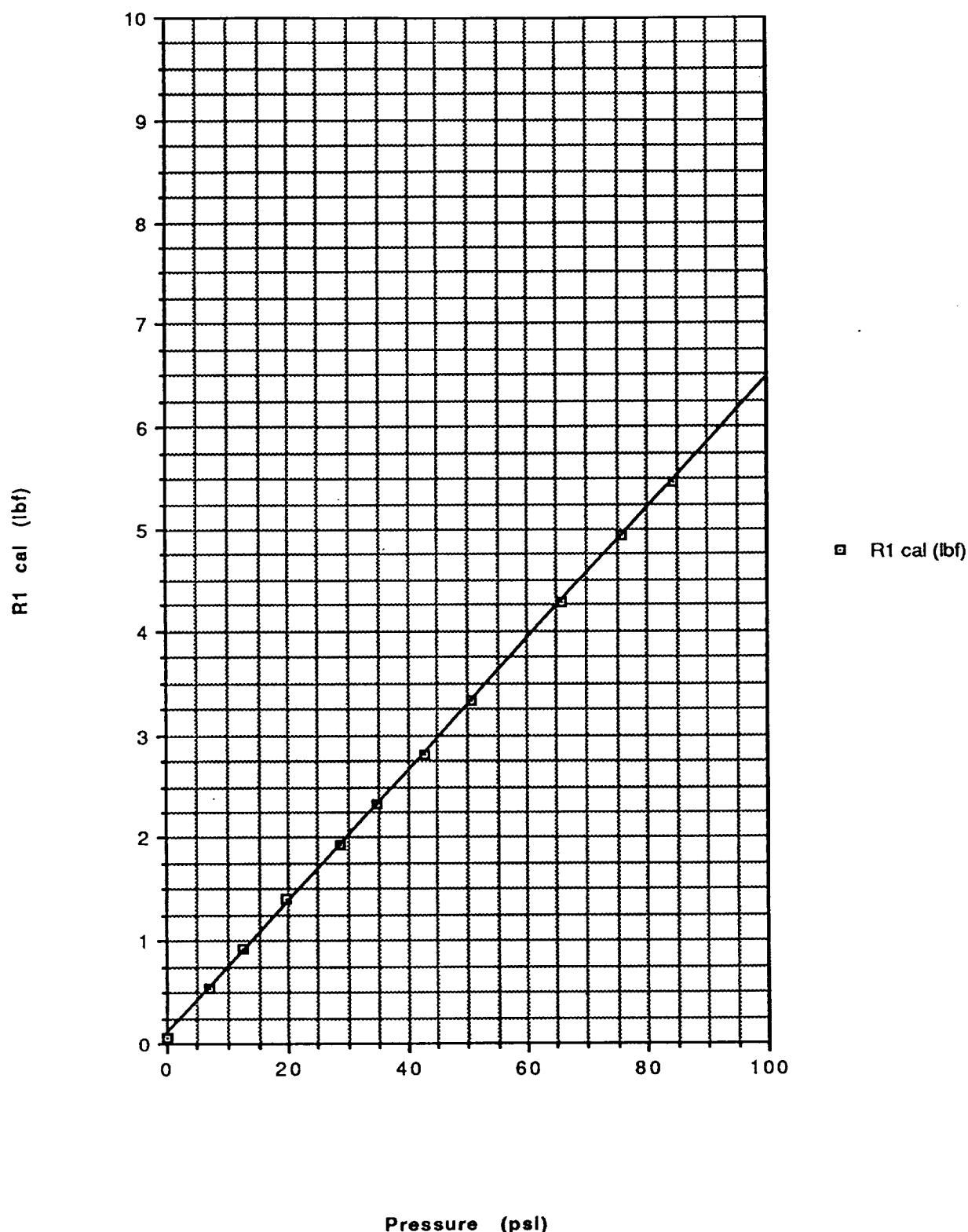
**Data from "8/15/91 Calibrated Straight"**

Figure 18

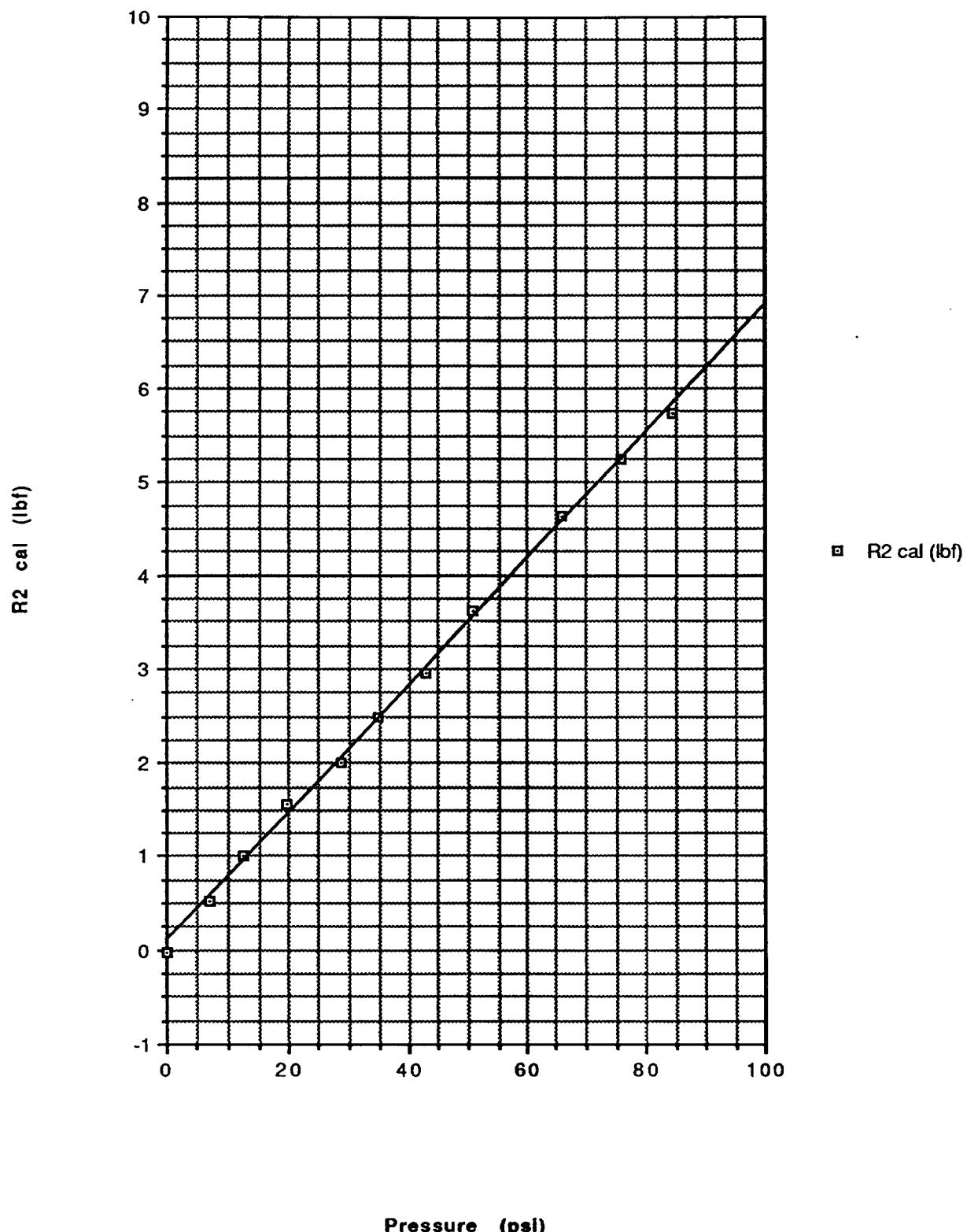
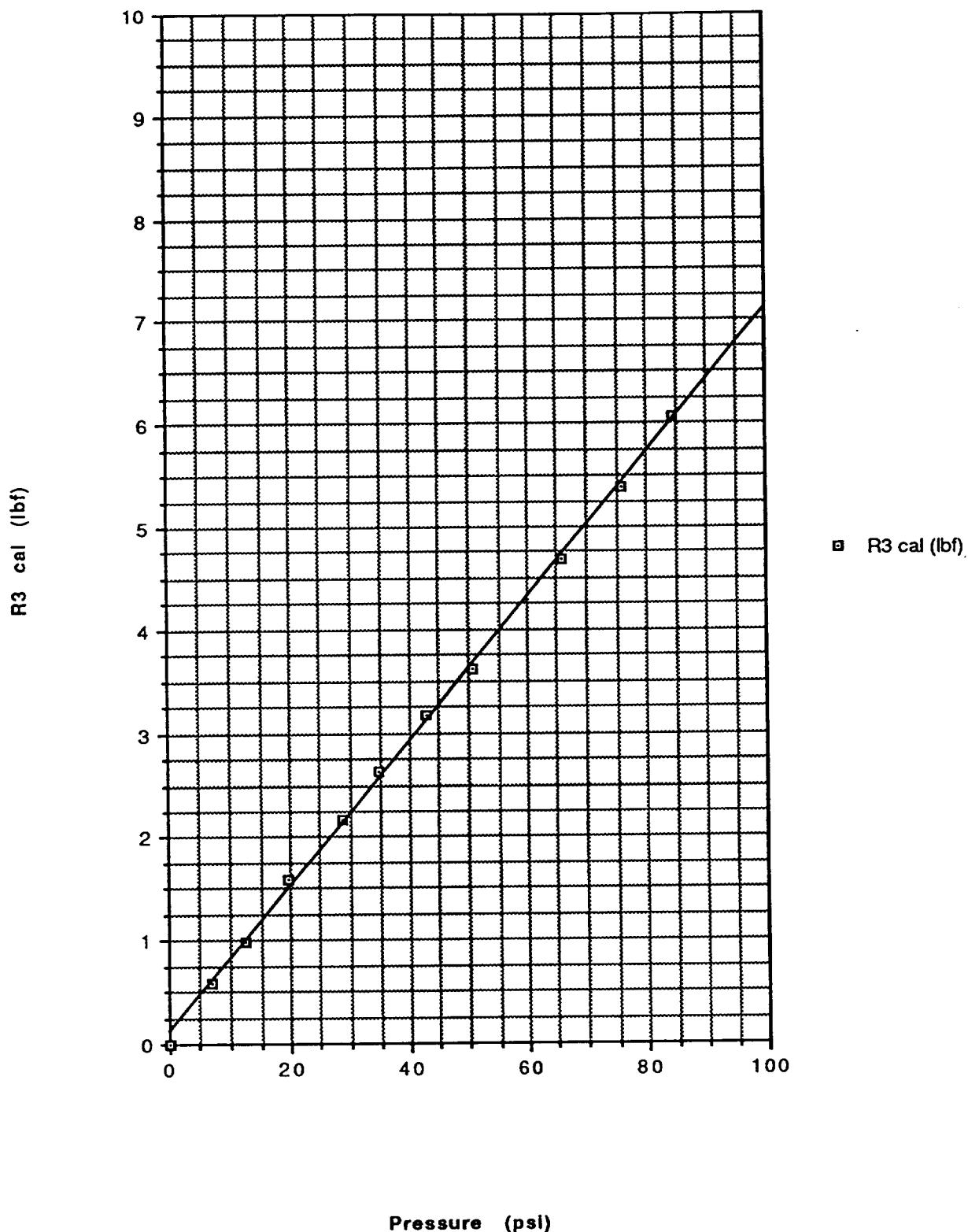
**Data from "8/15/91 Calibrated Straight"**

Figure 19

**Data from "8/15/91 Calibrated Straight"****Figure 20**

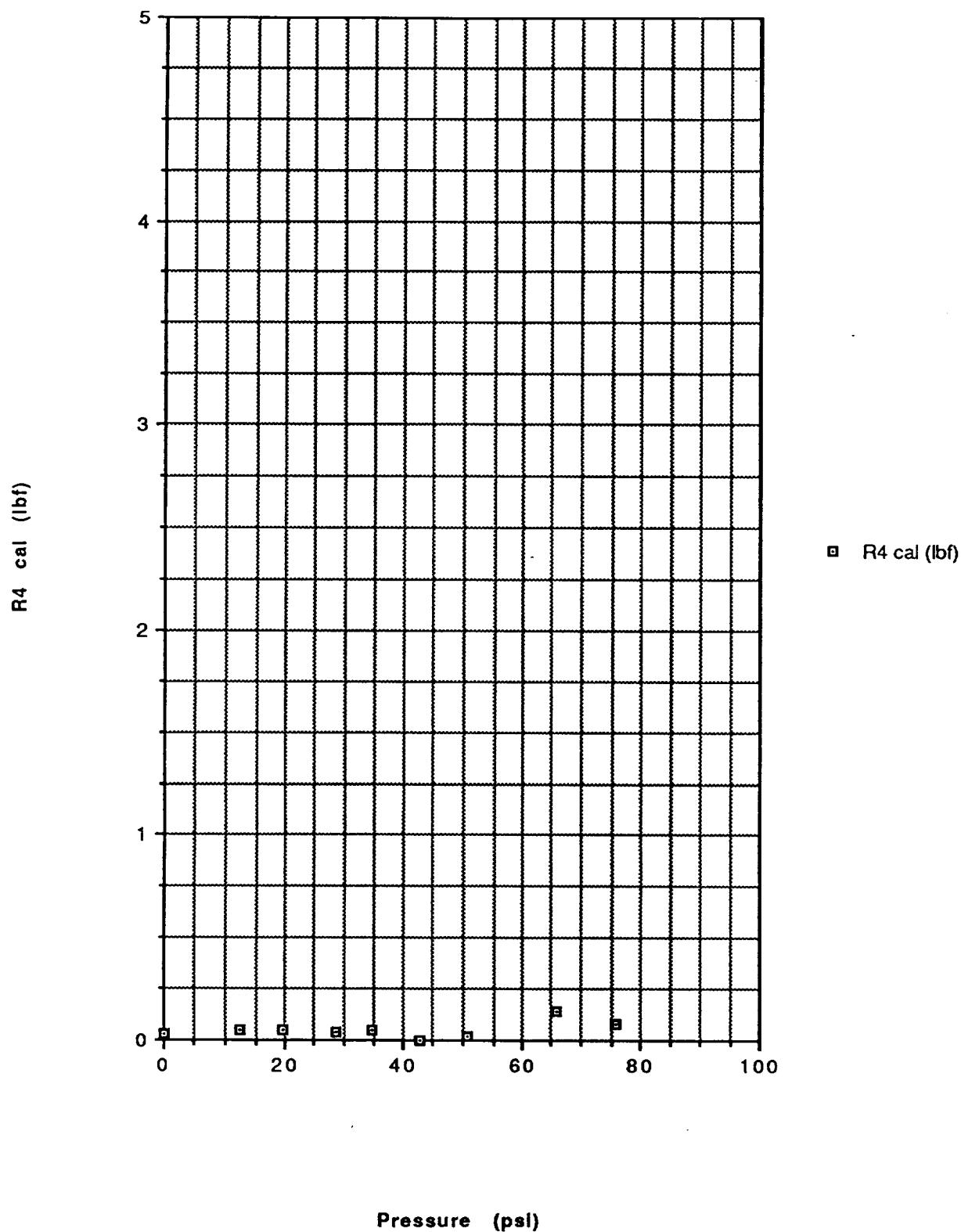
**Data from "8/15/91 Calibrated Straight"**

Figure 21

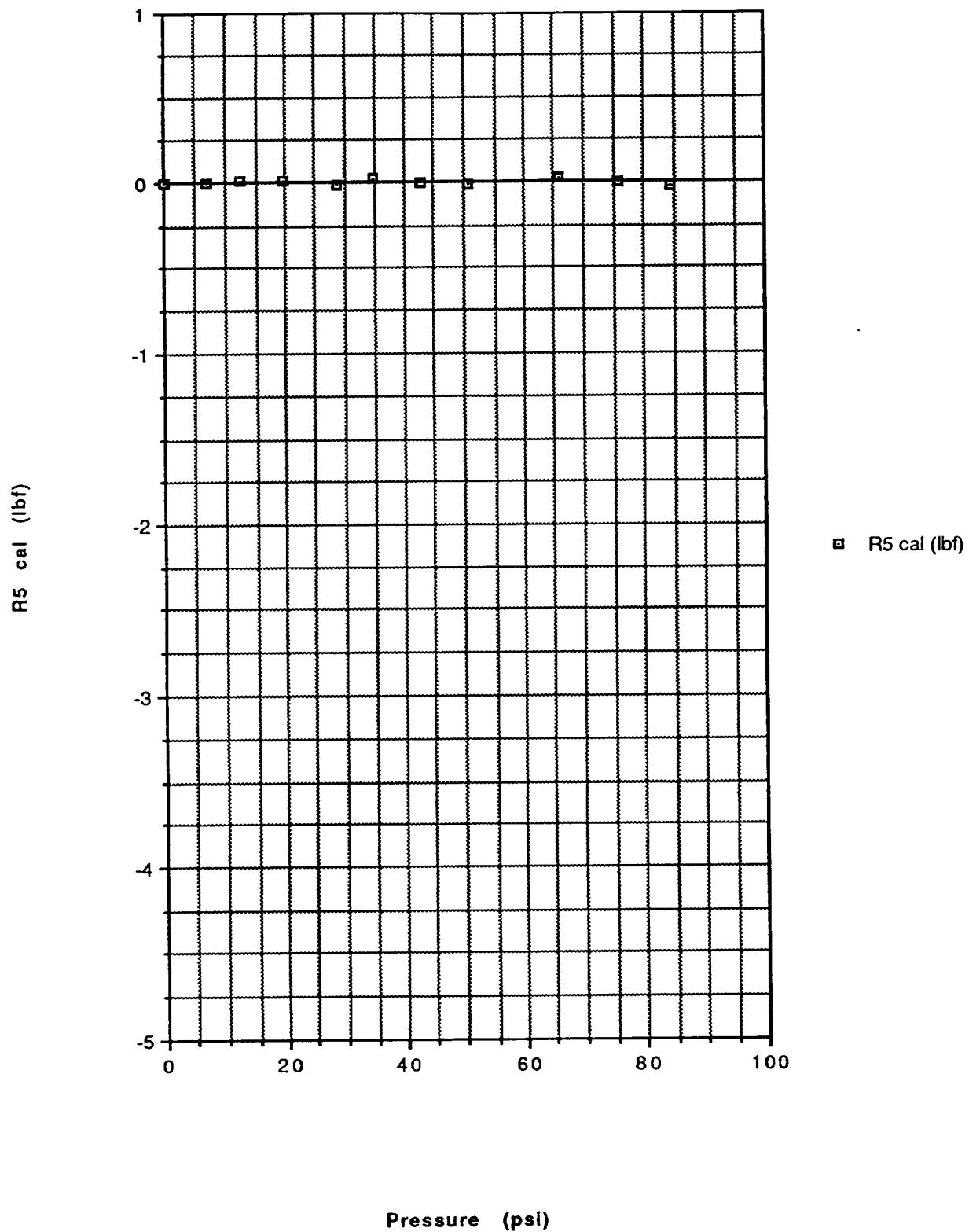
**Data from "8/15/91 Calibrated Straight"**

Figure 22

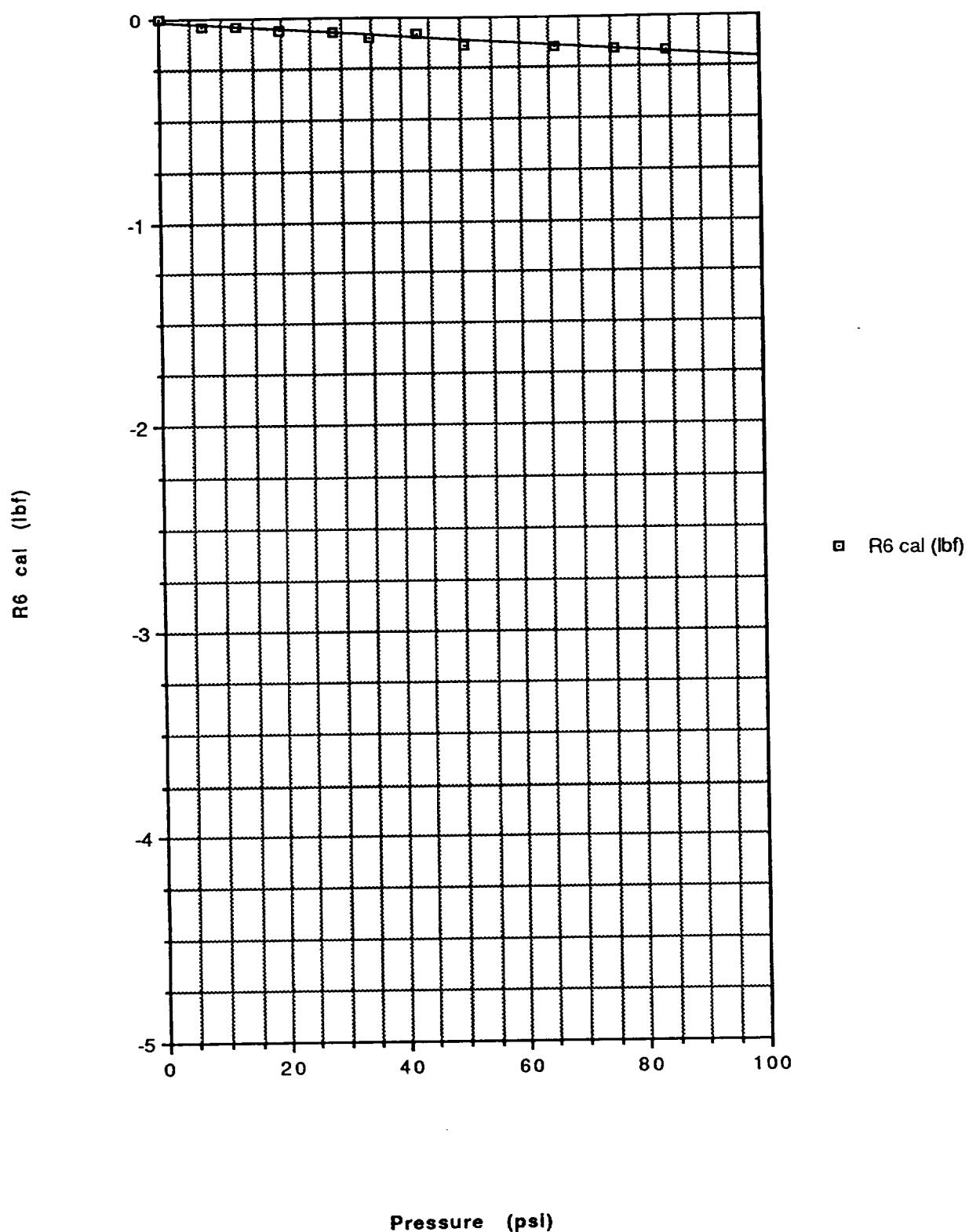
**Data from "8/15/91 Calibrated Straight"**

Figure 23

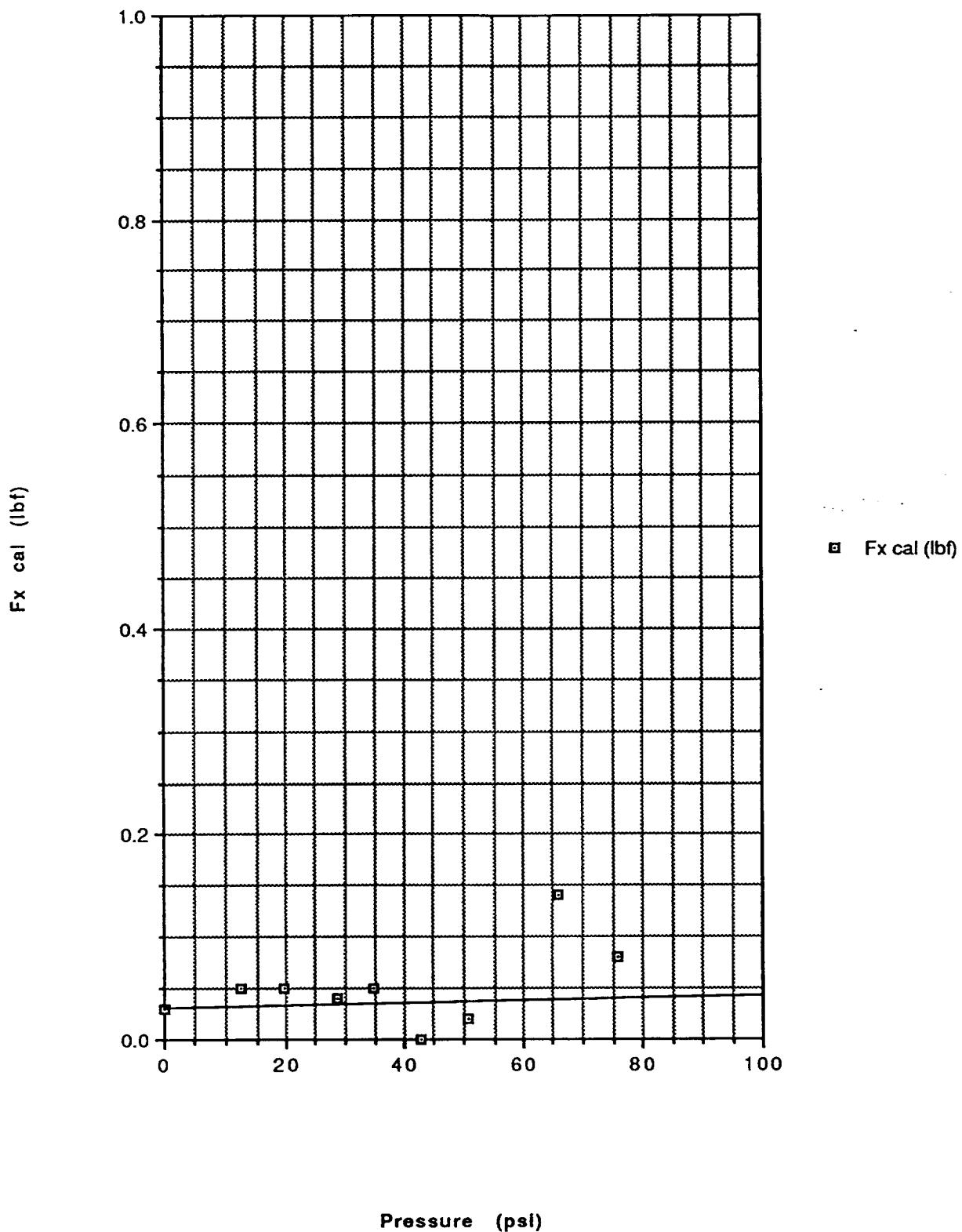
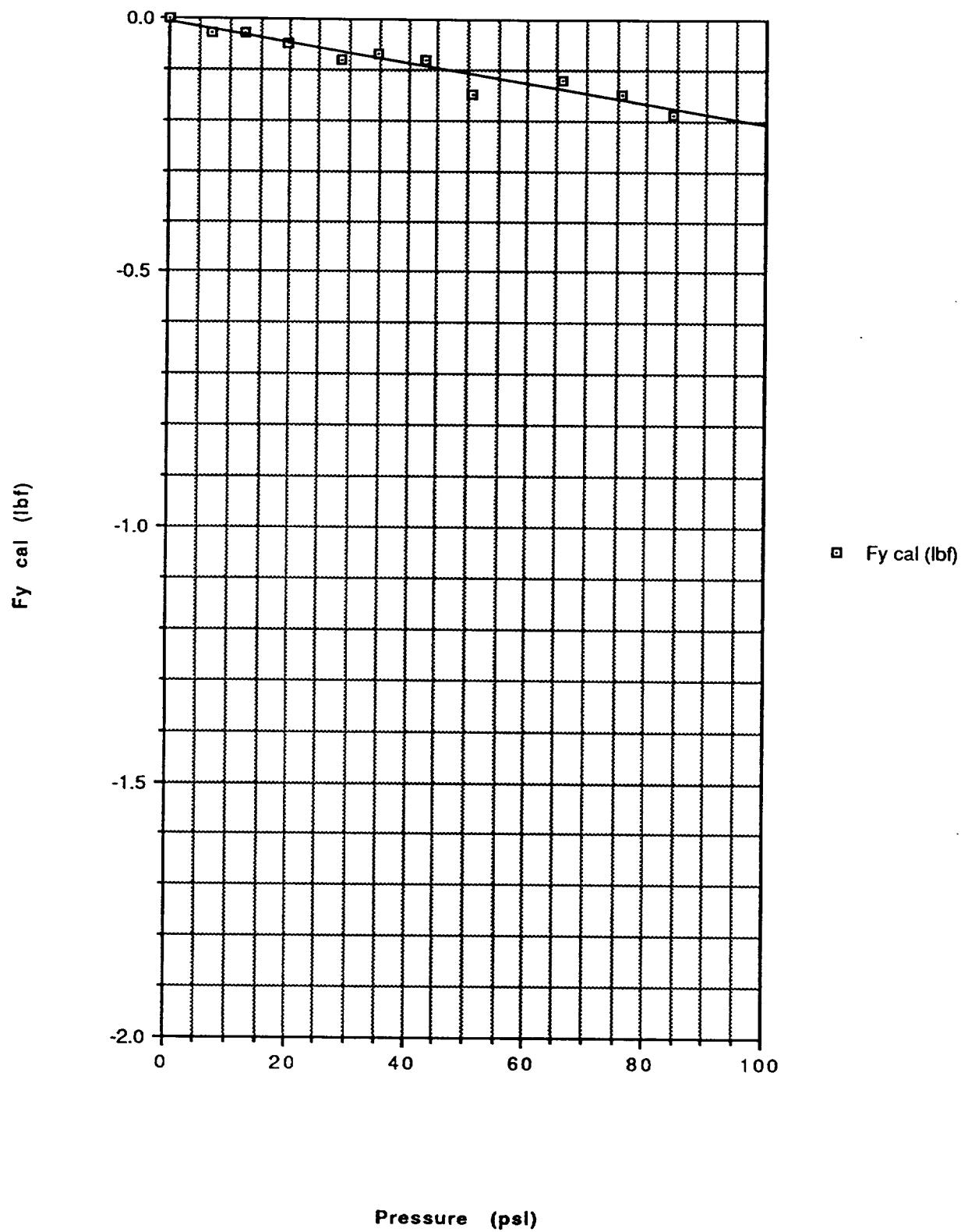
**Data from "8/15/91 Calibrated Straight"**

Figure 24

**Data from "8/15/91 Calibrated Straight"****Figure 25**

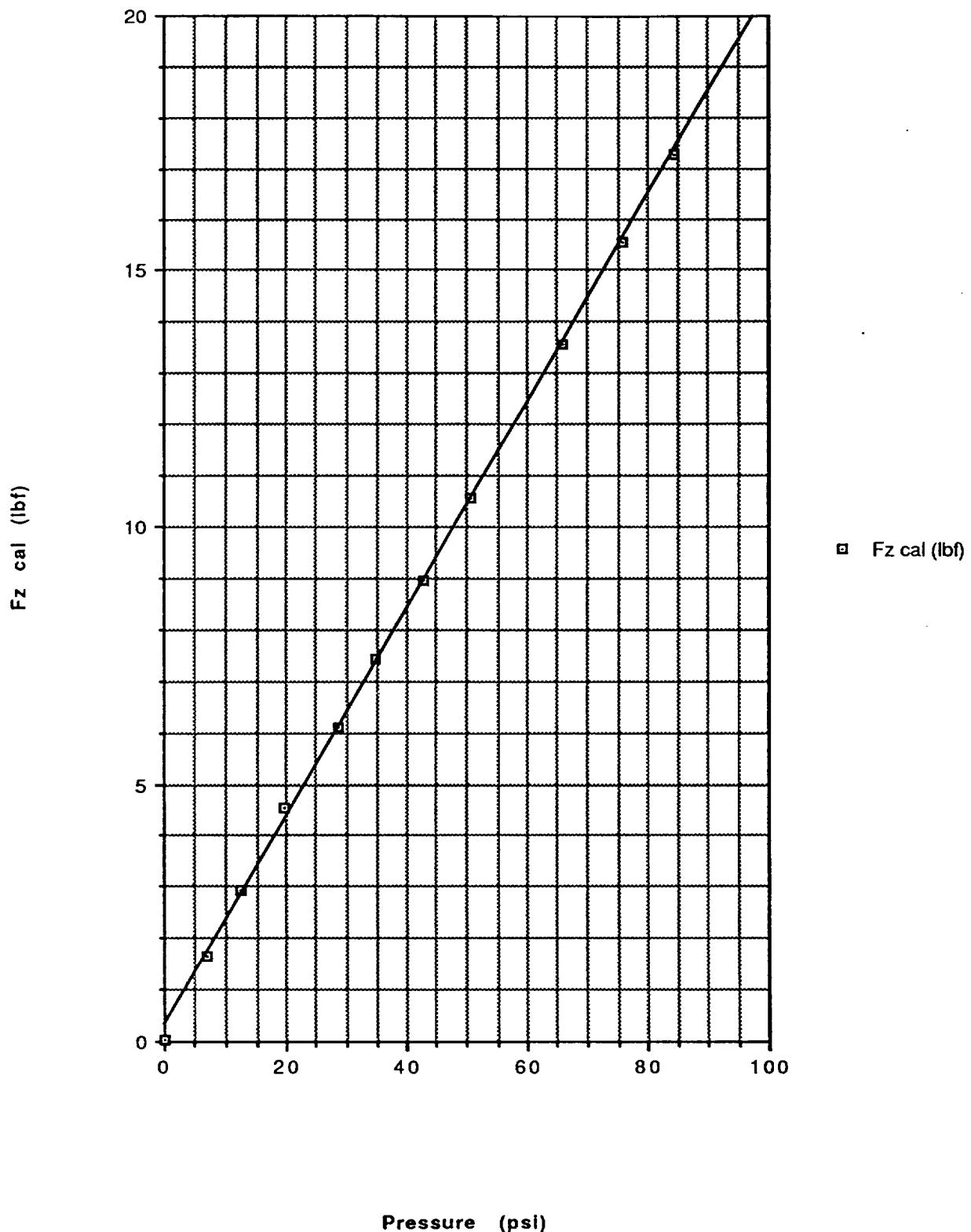
**Data from "8/15/91 Calibrated Straight"**

Figure 26

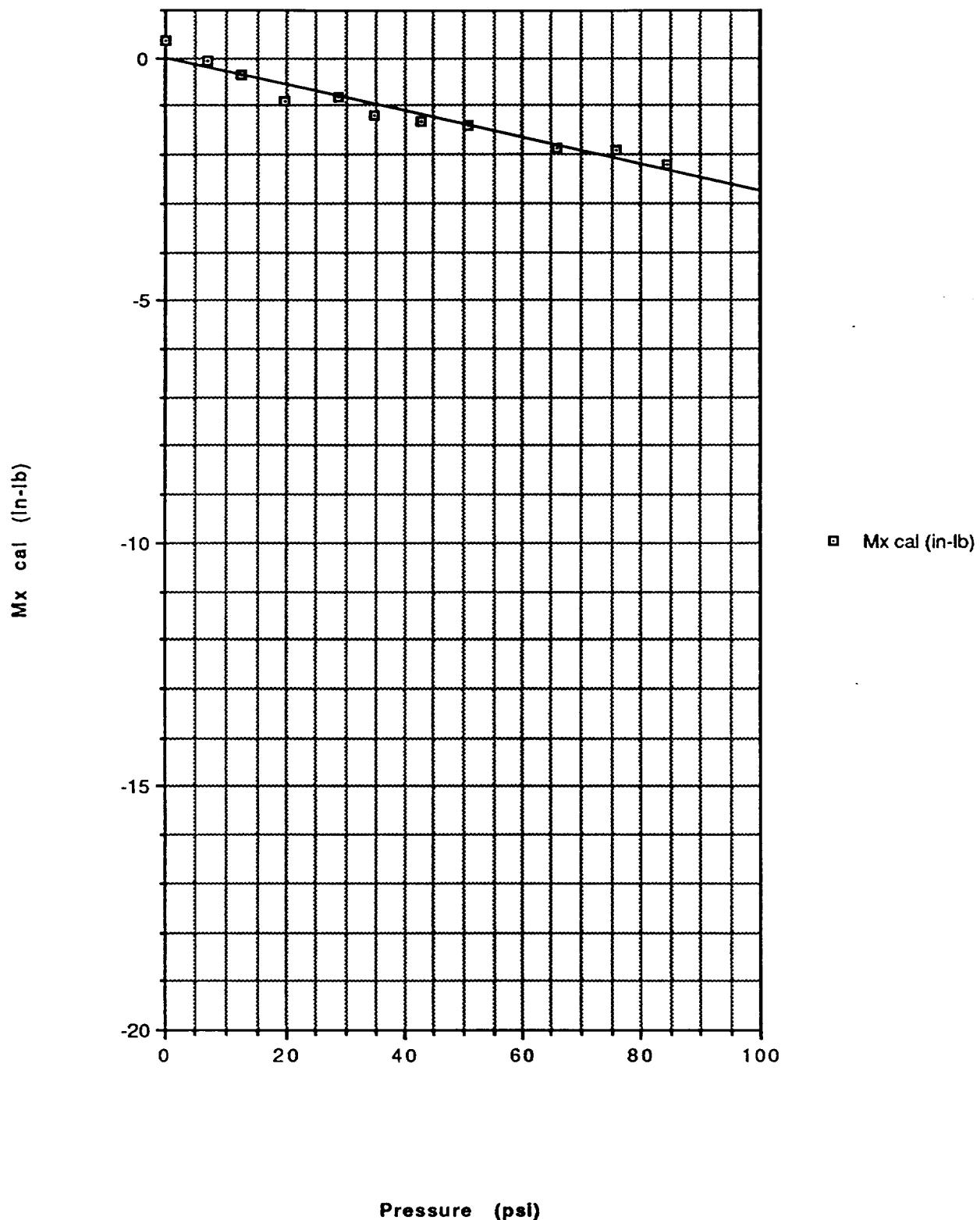
**Data from "8/15/91 Calibrated Straight"**

Figure 27

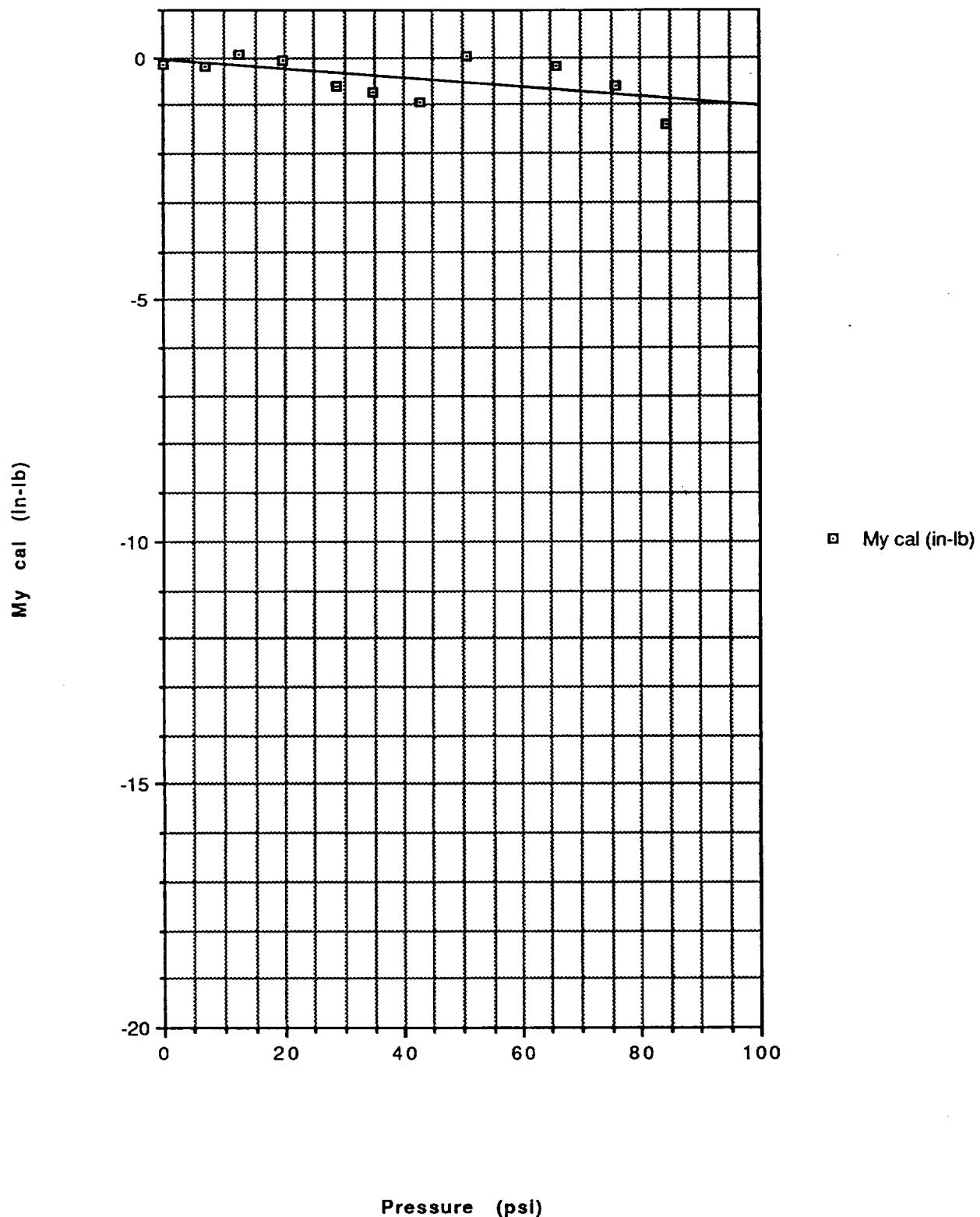
**Data from "8/15/91 Calibrated Straight"**

Figure 28

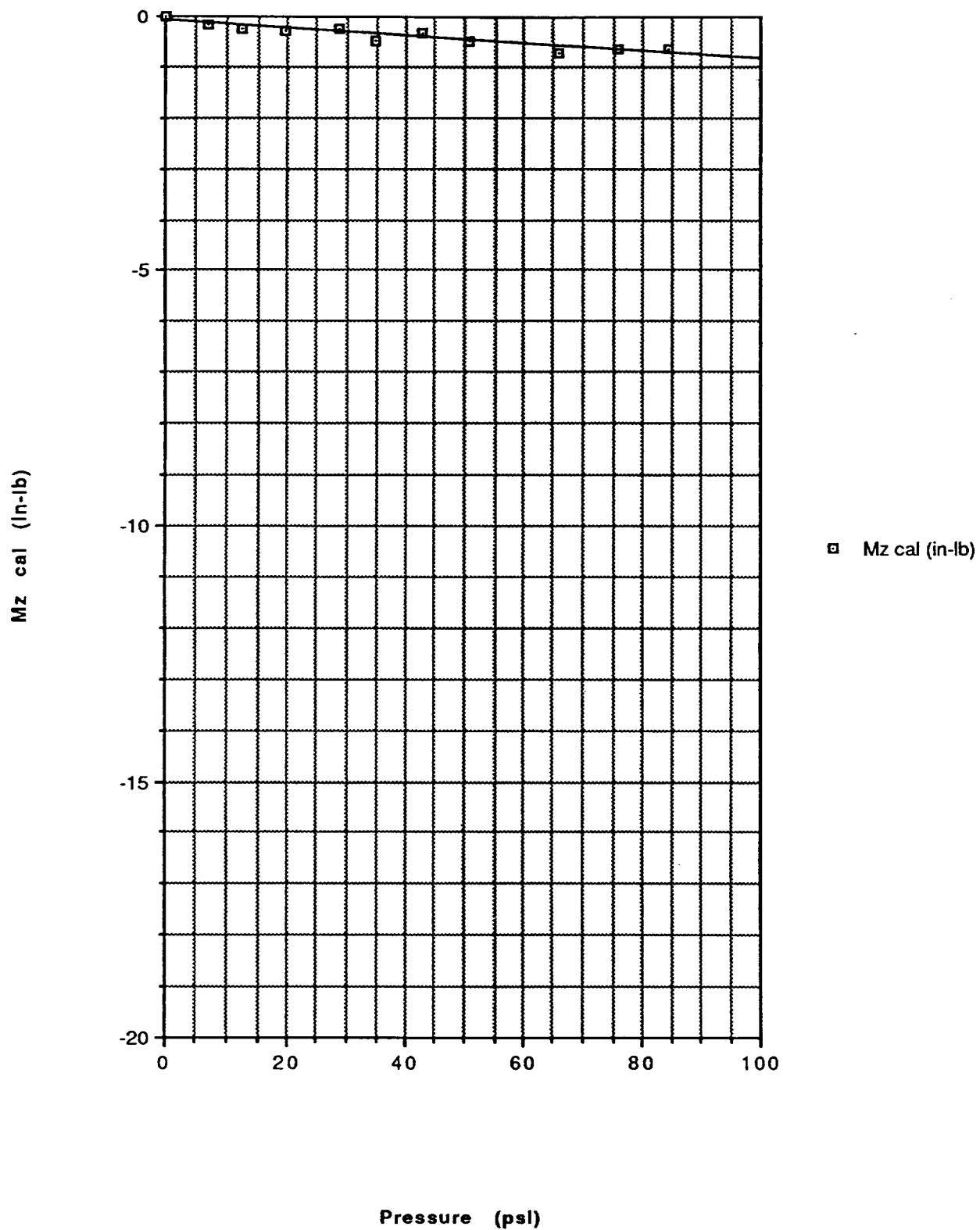
**Data from "8/15/91 Calibrated Straight"**

Figure 29

#### D. Repeatability of Test Stand (Statistical Analysis)

To test the repeatability of the test stand and the instruments ten readings at the same plenum pressures were taken. Four different pressures were used for the test, and the standard deviation and variance were calculated for each load cell. An assumption was made that the data had to follow a normal distribution. However, there was not enough time to collect enough data to show this distribution. This information is collected in Table 2. The variances of the load cell readings were low compared to the variances of the pressures. No correlation was found between the variance values and different pressure readings.

TABLE 2

41

## Summary of Statistical Calculations

	R1	R2	R3	R4	R5	R6
--	----	----	----	----	----	----

P=8.57 psi

<b>Mean</b>	0.674	0.353	0.986	-0.017	-0.124	-0.031
<b>Standard Dev.</b>	0.0344	0.04001	0.03688	0.02584	0.00699	0.00995
<b>Variance</b>	0.00118	0.0016	0.00136	0.0006678	0.000049	0.000099

P=24.63 psi

<b>Mean</b>	1.797	0.832	2.566	-0.07	-0.306	-0.078
<b>Standard Dev.</b>	0.011595	0.042635	0.03835	0.04807	0.00966	0.01398
<b>Variance</b>	0.0001344	0.001817	0.00147	0.002311	0.0000933	0.0001956

P=41.08 psi

<b>Mean</b>	2.906	1.226	4.101	-0.19	-0.476	-0.095
<b>Standard Dev.</b>	0.01577	0.23434	0.04358	0.0616	0.010749	0.09675
<b>Variance</b>	0.0002489	0.054915	0.001899	0.0038	0.0001156	0.009361

P=74.38 psi

<b>Mean</b>	5.013	2.281	7.312	-0.388	-0.814	-0.24
<b>Standard Dev.</b>	0.0361478	0.04067	0.082435	0.072234	0.008433	0.013498
<b>Variance</b>	0.001307	0.001654	0.006795	0.005478	0.0000711	0.0001822

### E. Procedure Listing

The following describes the procedure for collecting data from the thrust stand:

1. Perform a Plug nozzle test and print results.
2. Perform the required thrust tests and print results.
3. Enter the data in the Excel spreadsheet "DATA"
4. Open Excel spreadsheet "WORKSHEET BASE" and load Plug data.
5. Copy results into the 'Scrapbook' and import to Cricket Graph file.
6. Graph all load cell reactions of Plug data vs. supply pressure.
7. Perform a linear regression (simple curve fit) and record equations.
8. Open Excel spreadsheet "WORKSHEET BASE W/ CAL" and load run data.
9. Enter in new calibration equations.
10. Copy results in the 'Scrapbook' and import to Cricket Graph file.
11. Graph results.

## CONCLUSIONS

1. By the addition of the new table, blocks, and bellows, the moment in the Z direction was greatly reduced.
2. The new plenum chamber, along with careful alignment, greatly reduced the bending moments in the X and Y directions.
3. The application of calibration runs and curves can greatly improve the accuracy of the thrust readings, as this reduces the effects of the line pressure. All forces and moments were reduced to nearly zero (with the exception of Fz).
4. The data acquisition system readings were shown to be highly repeatable via the statistical analysis.
5. The calibration equations for the system are listed as Equations 7-12.

## REFERENCES

Avallone, Eugene A.; Baumeister III, Theodore (1986) "Mark's Standard Handbook for Mechanical Engineers" 9th Edition McGraw Hill.

Carpenter, T.W. ; etc.. (1990) "Design and Evaluation of Thrust Vectored Nozzles Using a Multicomponent Thrust Stand," Final progress report 10/1/88-1/31/90, NASA-Ames Grant Number NAG 2-559.

Flake, Scott (1990) "Comparison of Straight and 15 degree vectored Nozzles using a six component thrust stand", Senior Project, Cal Poly State University

McIntosh, Greg (1990) "Thrust vectoring research project", Senior Project, Cal Poly State University

Spiegel, Murray (1961) "Statistics", McGraw Hill

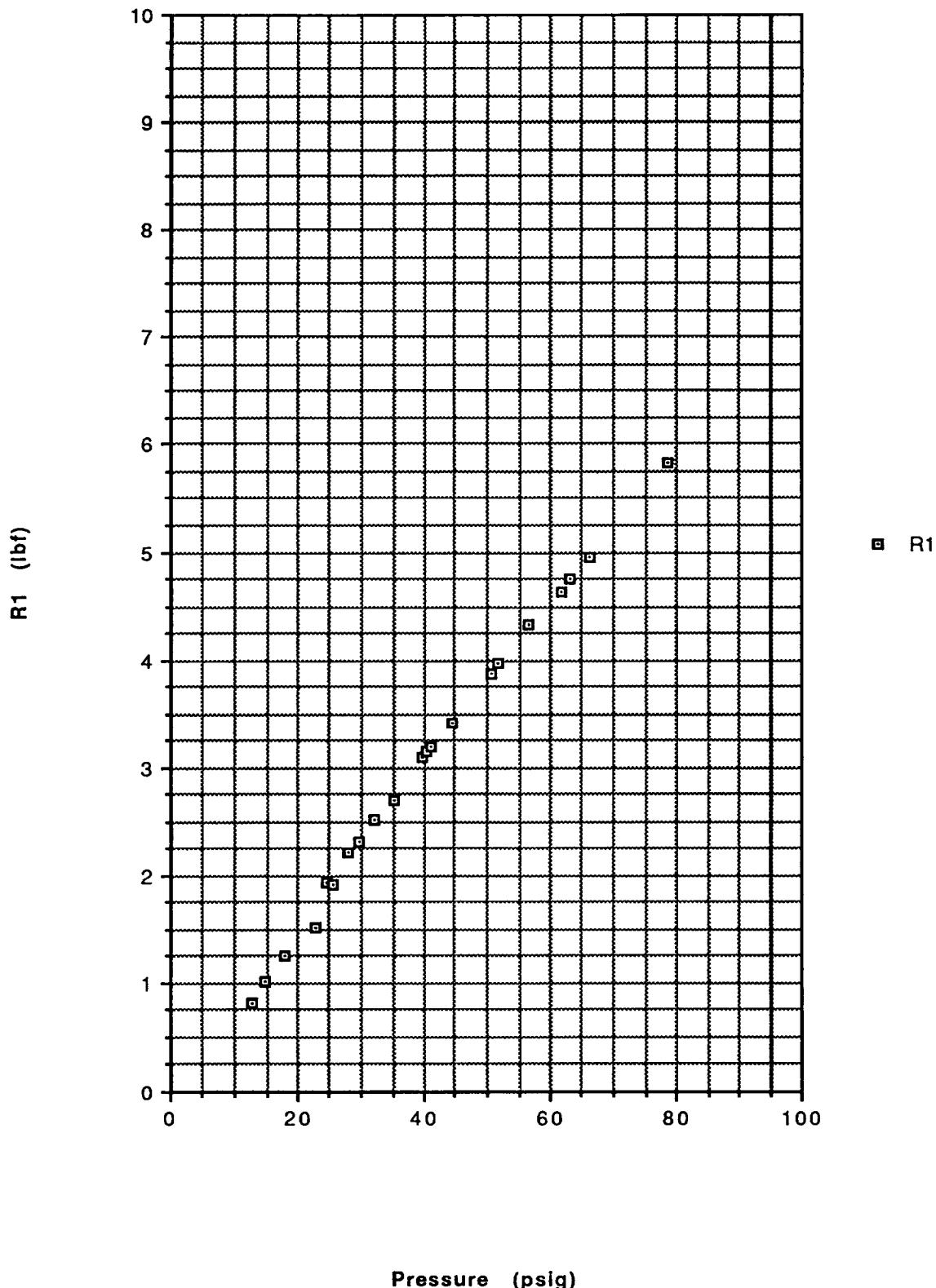
Wark, Kenneth D. (1988) "Thermodynamics" 5th Edition, McGraw Hill

Zucrow, M.J.; Hoffman, J.D., "Gas Dynamics - Volume I" John Wiley & Sons

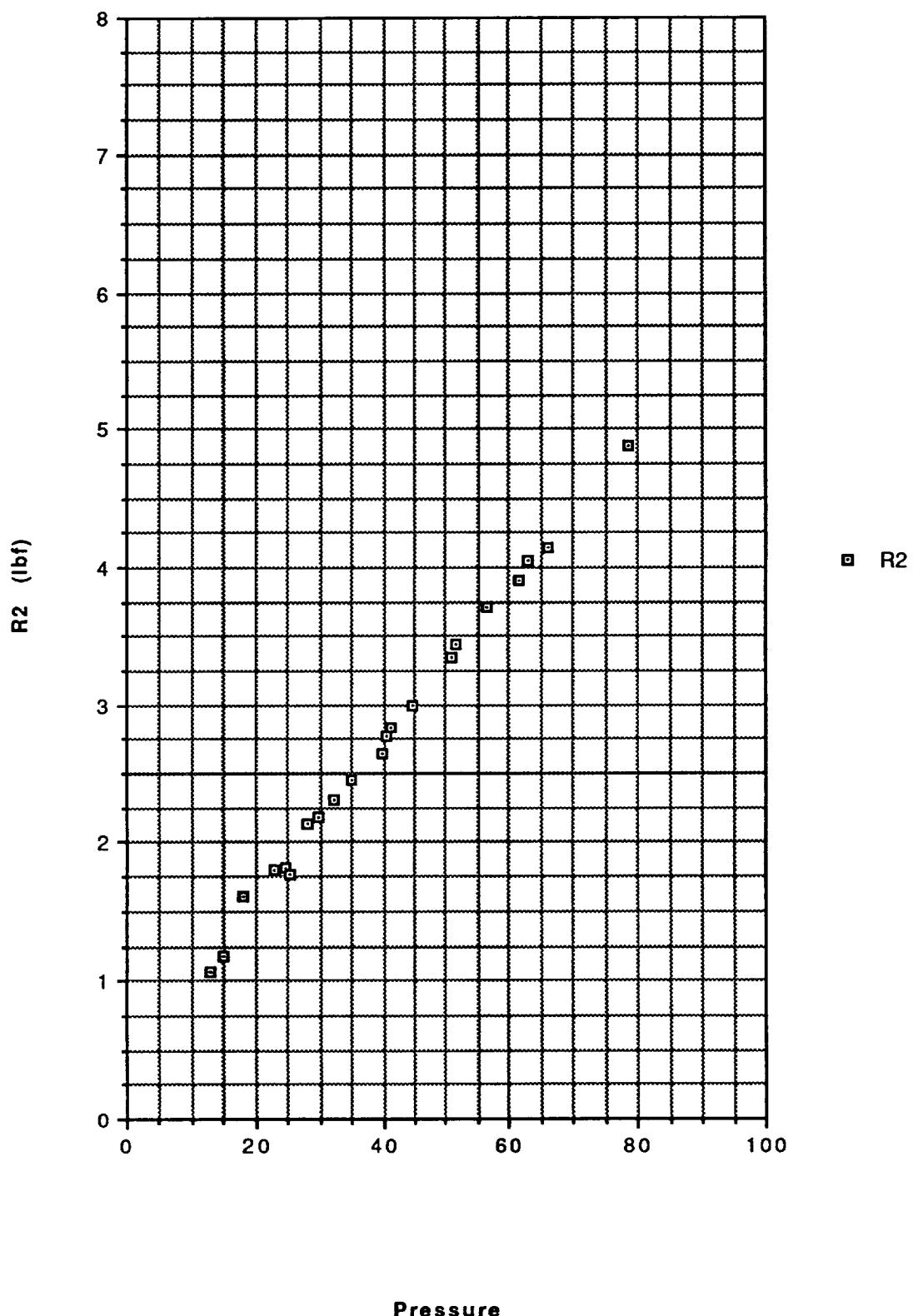
## APPENDIX A

12/19/90 STRAIGHT NOZZLE RUN

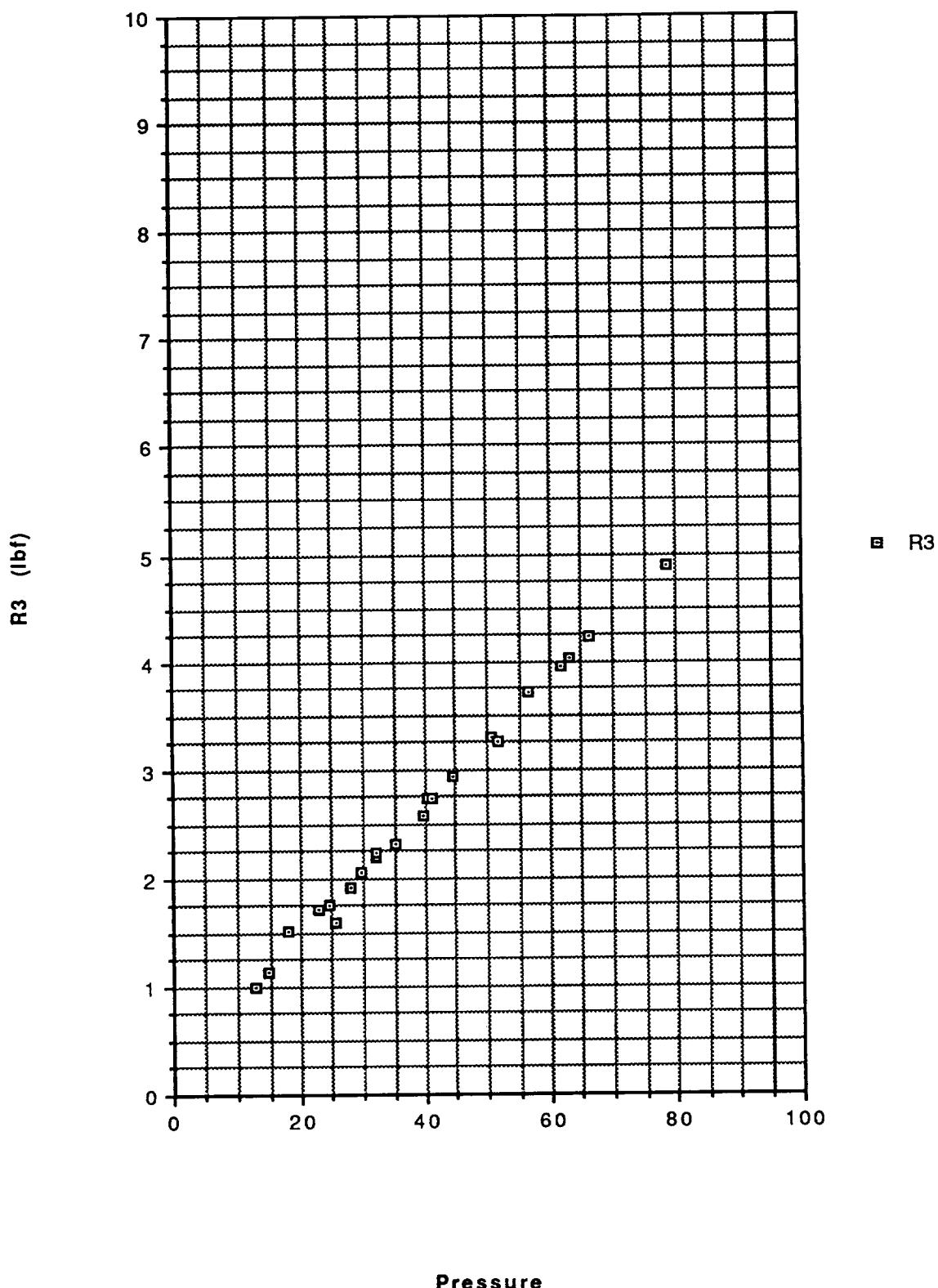
**Data from "12/19/91 straight"**



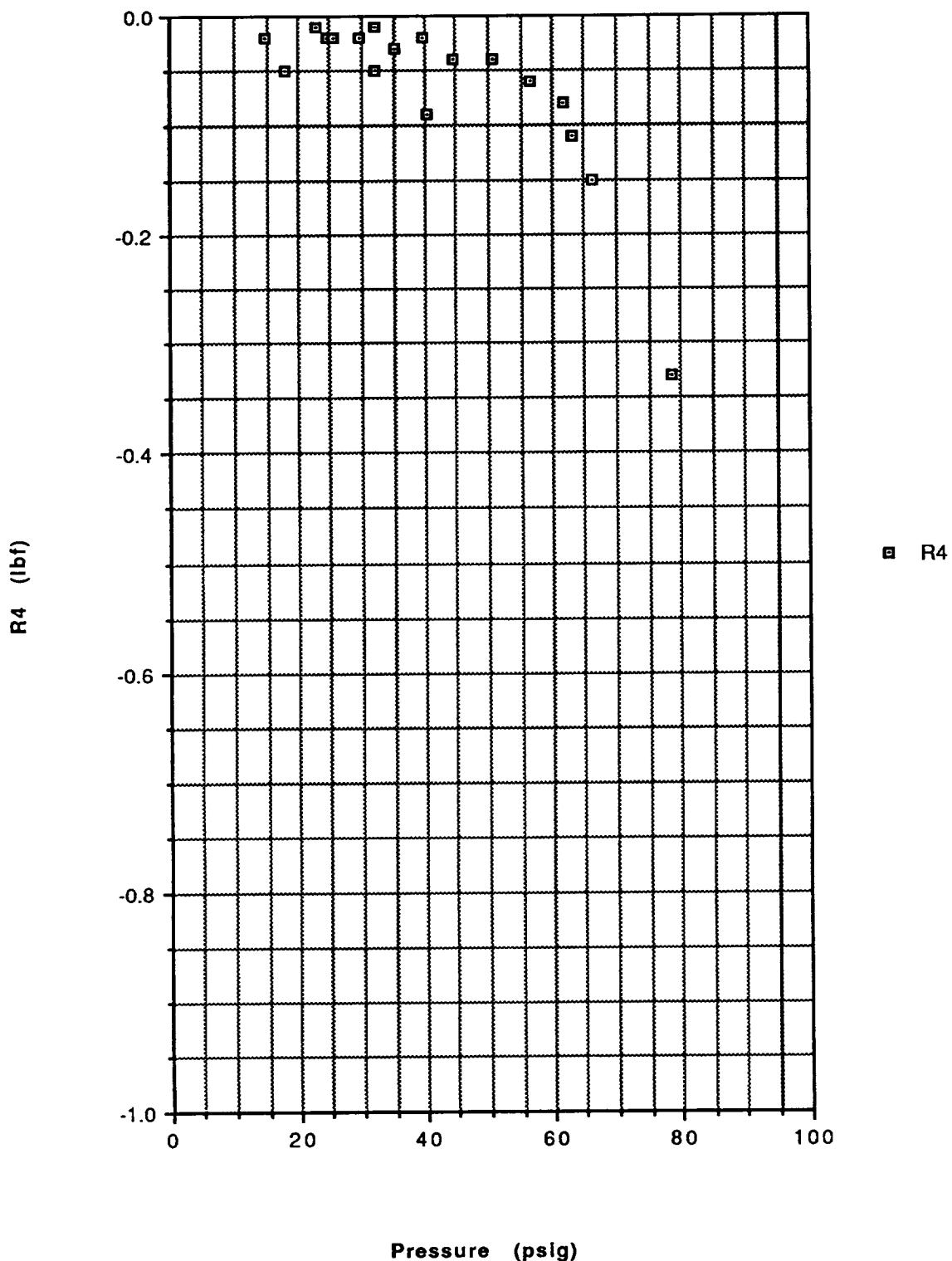
**12/19/90 straight**



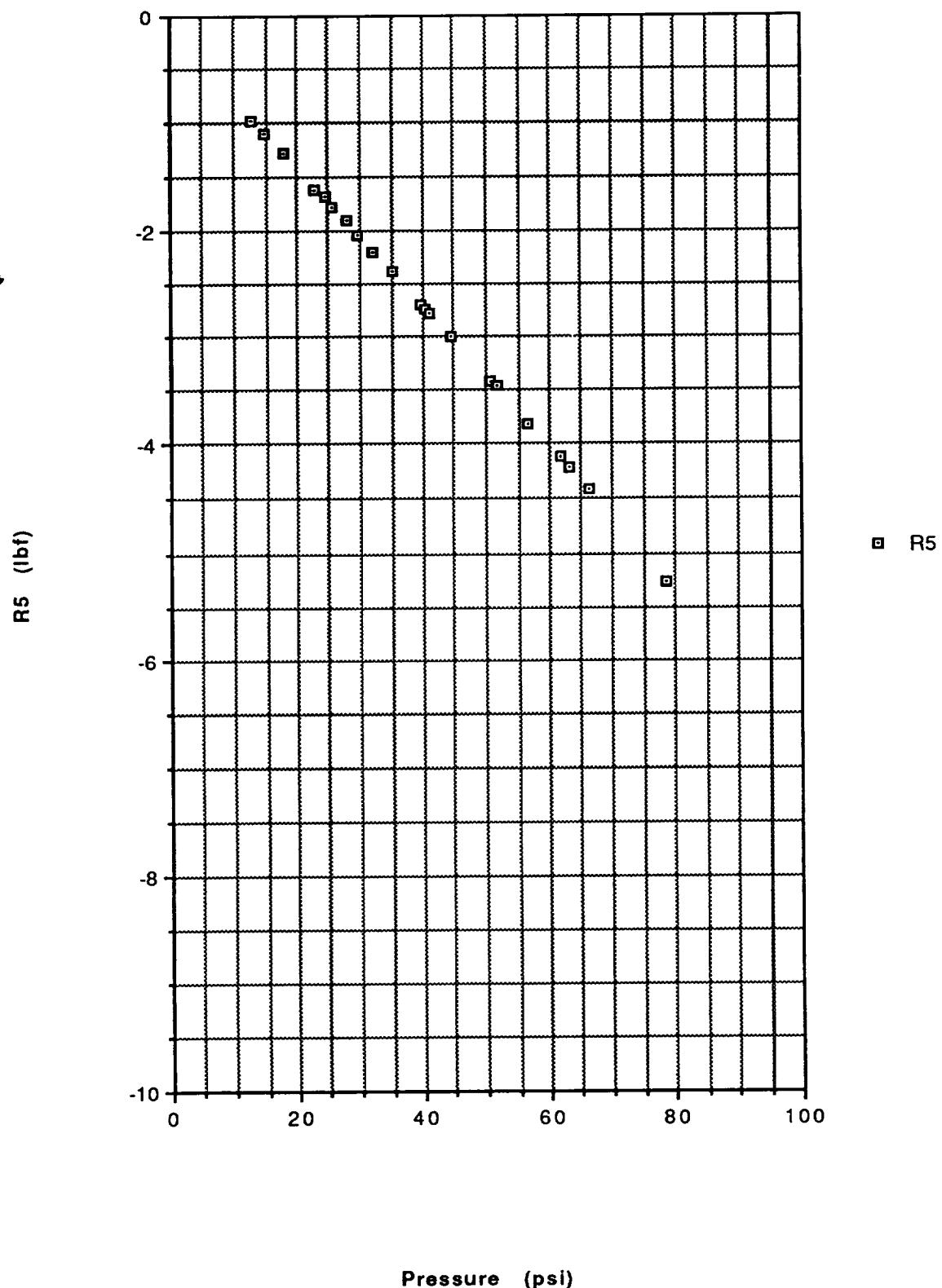
12/19/90 straight



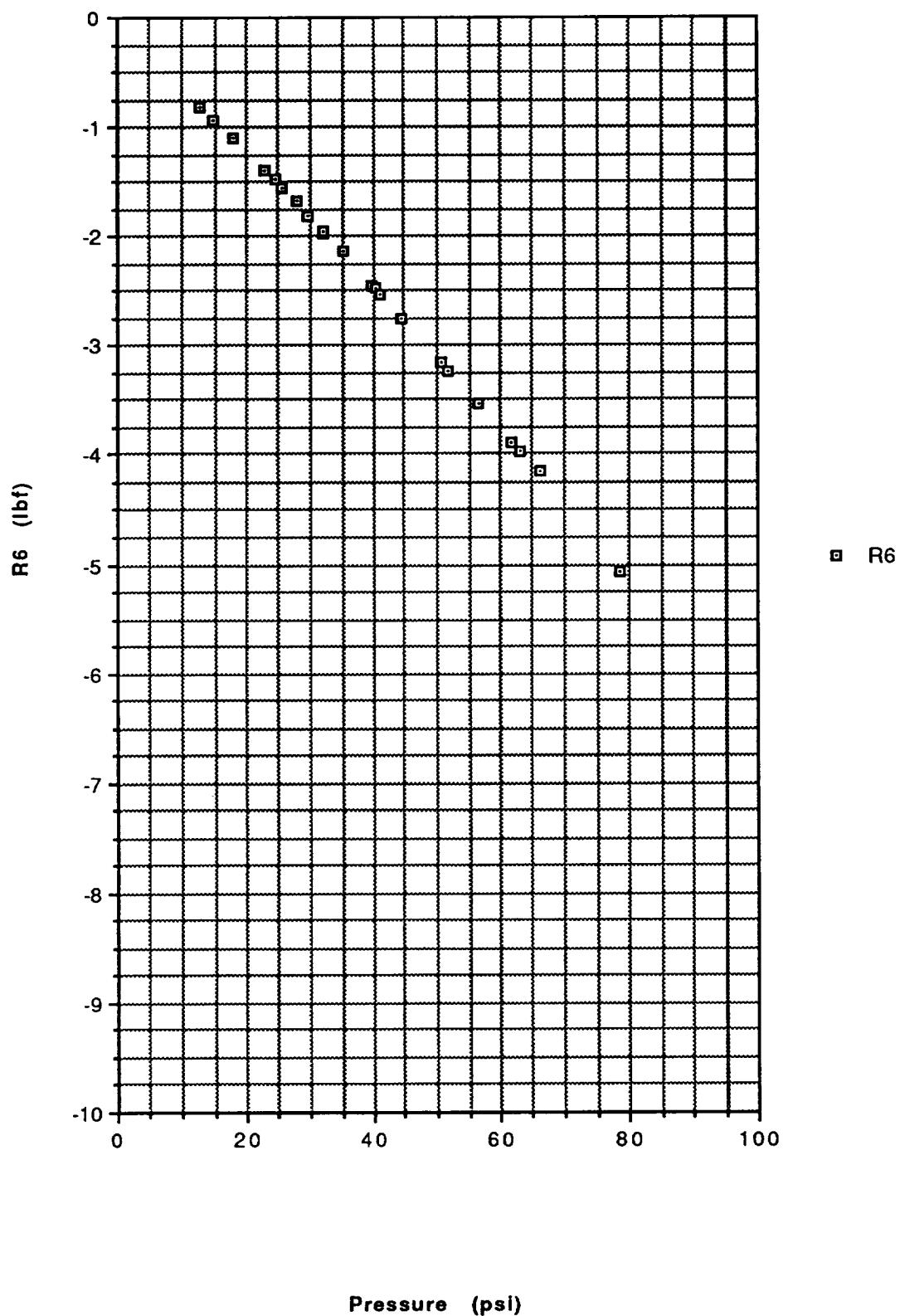
**12/19/90 Straight**



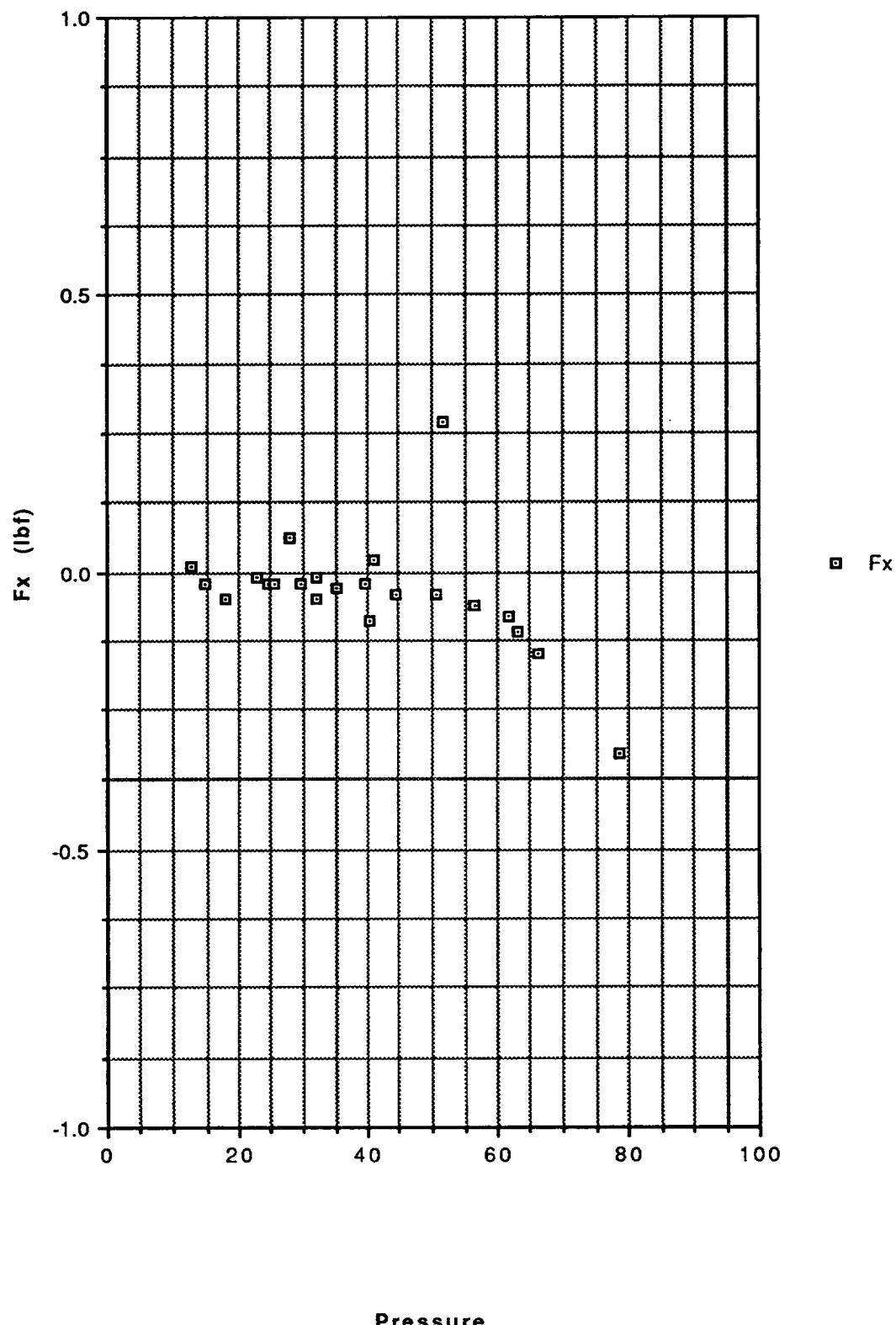
12/19/90 Straight



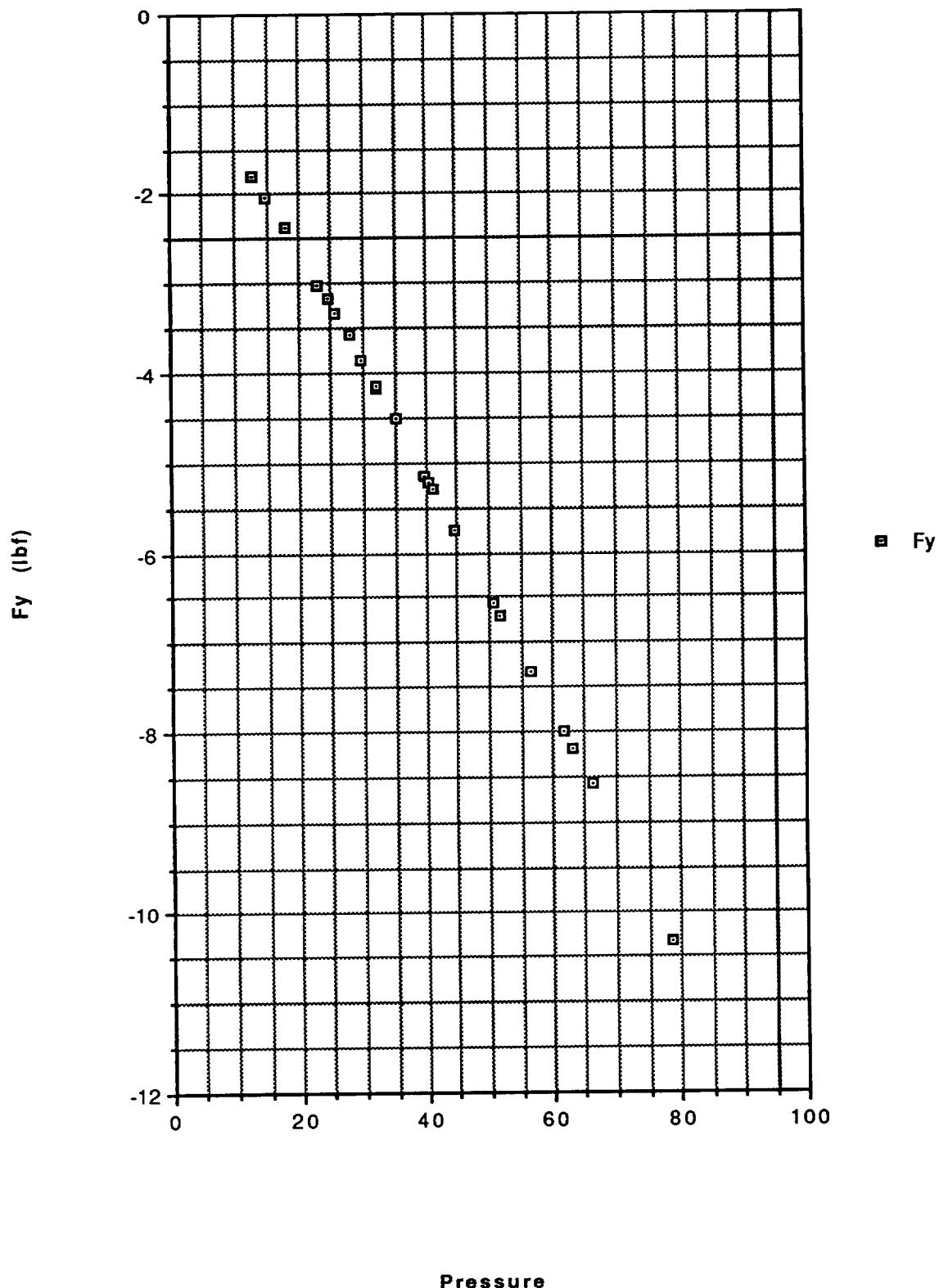
**12/19/90 Straight**



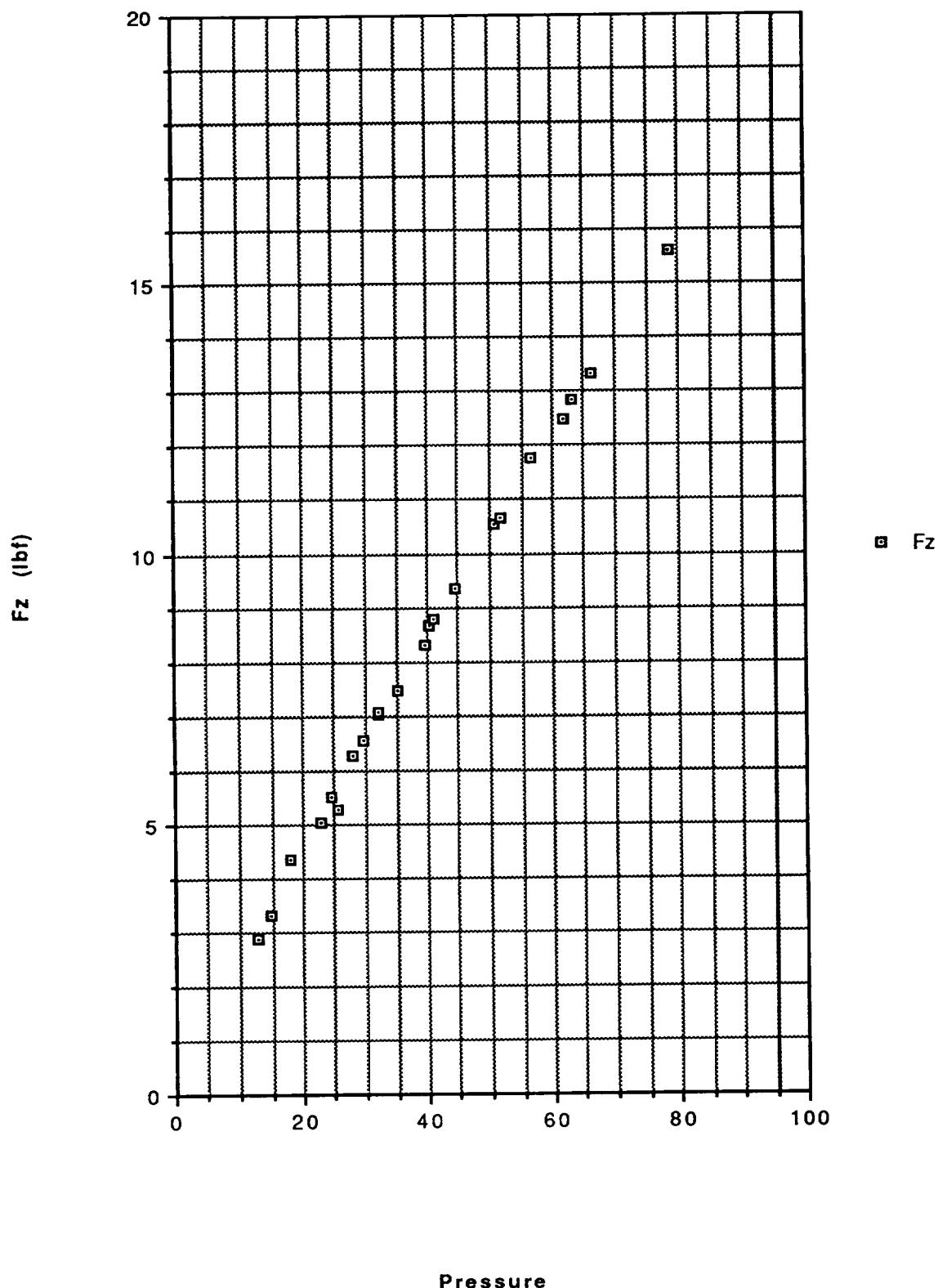
**12/19/90 Straight Nozzle**



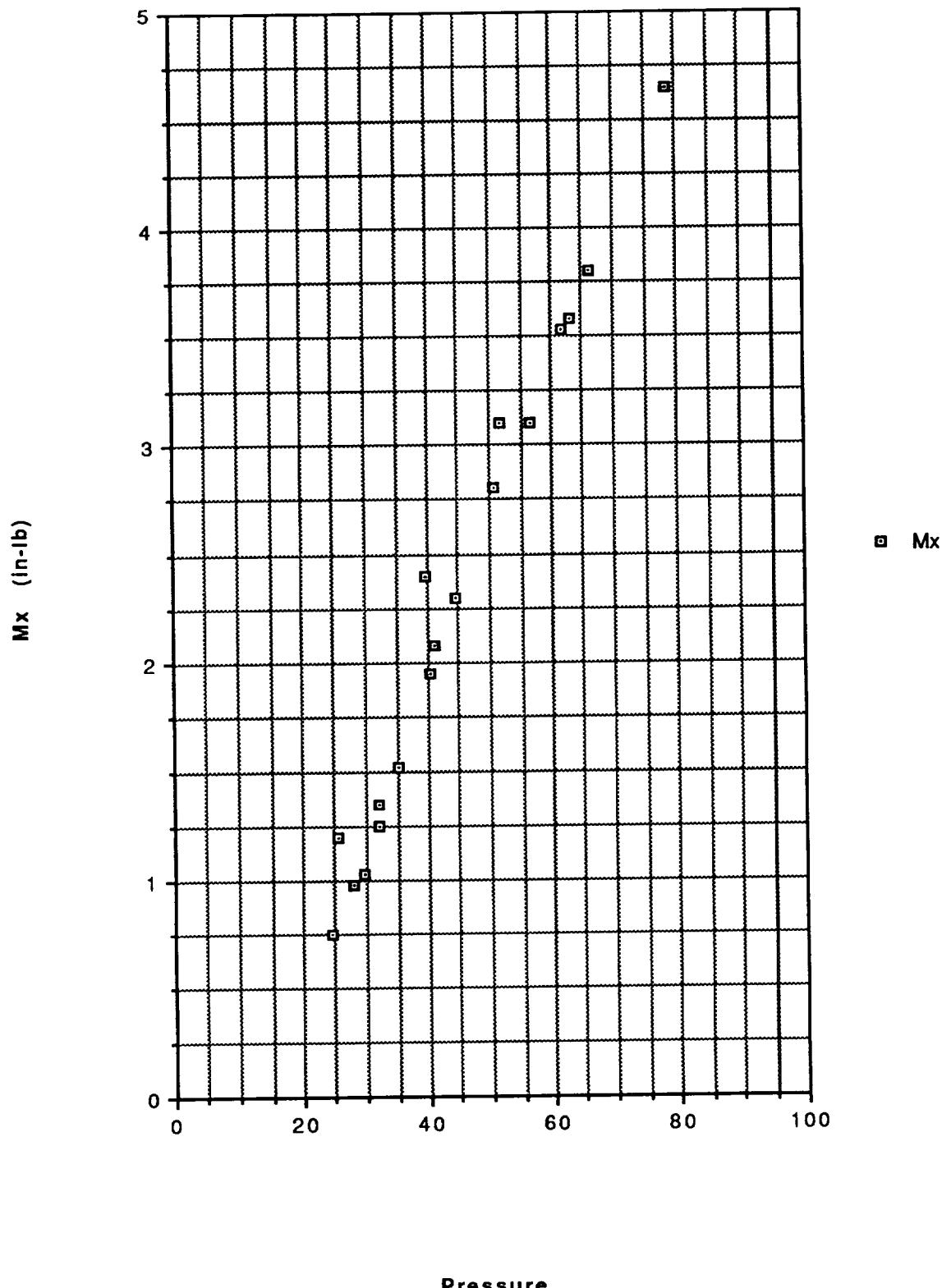
12/19/90 Straight



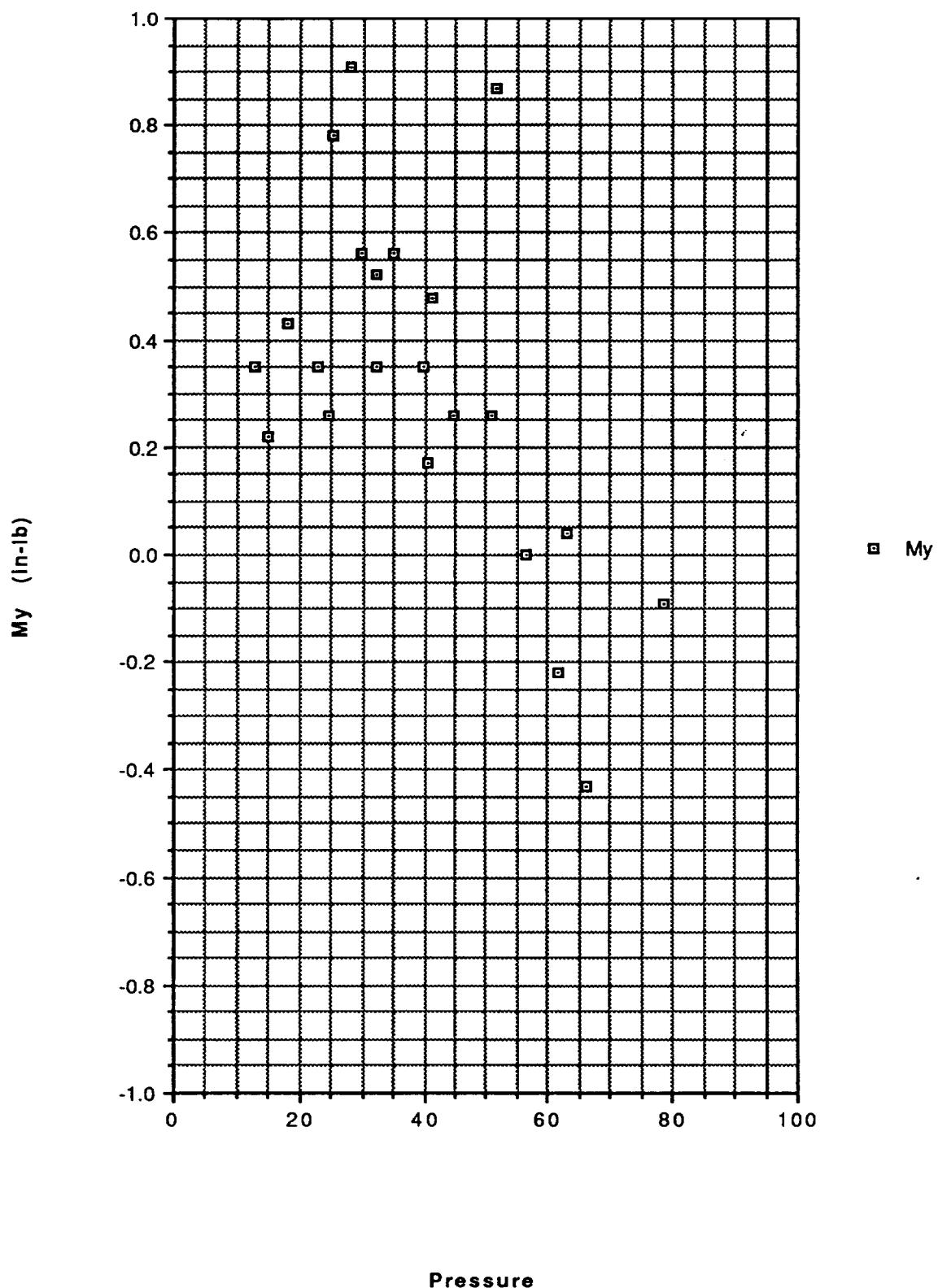
**12/19/90 Straight Nozzle**



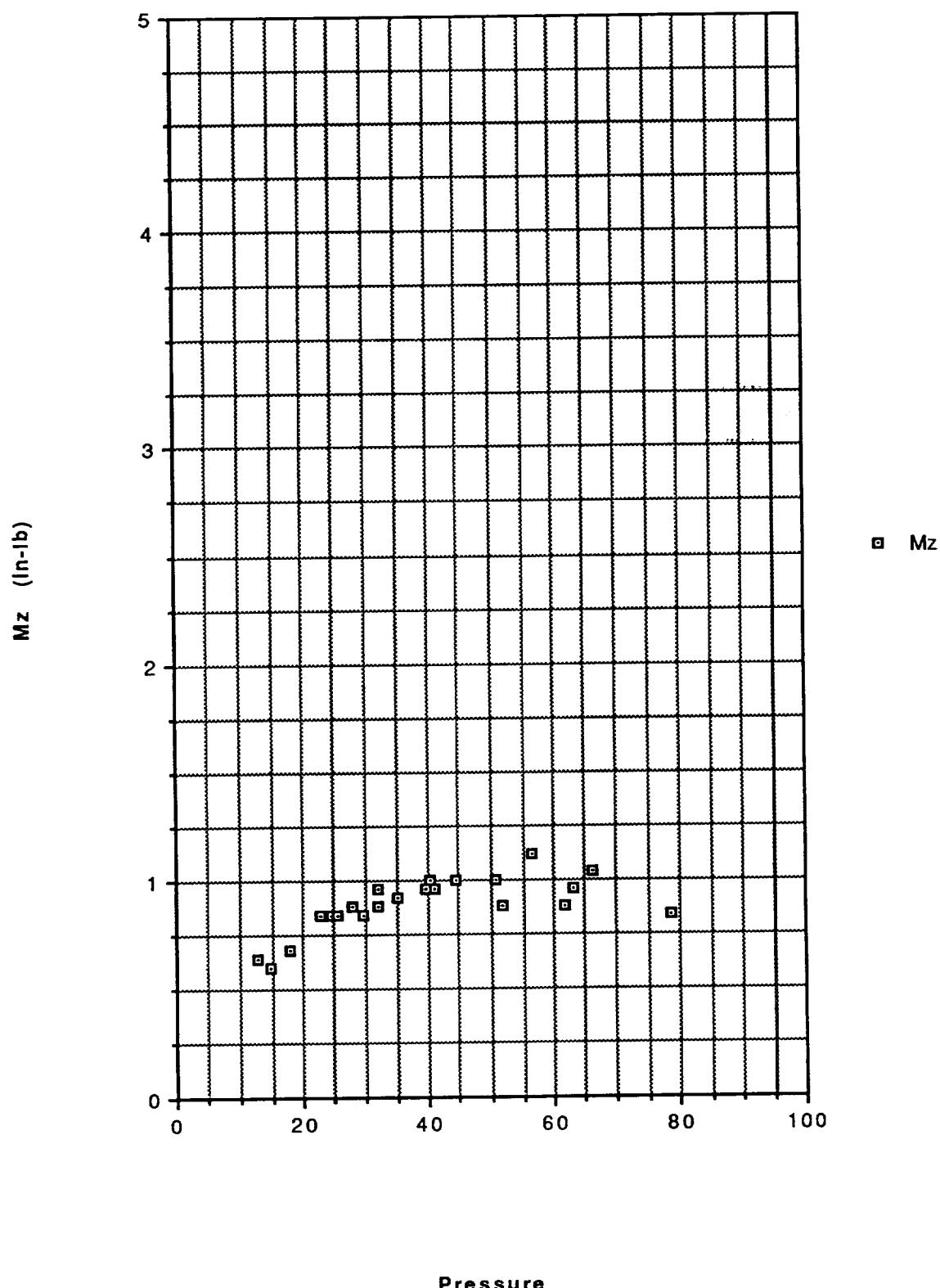
**12/19/90 Straight**



**12/19/90 Straight**



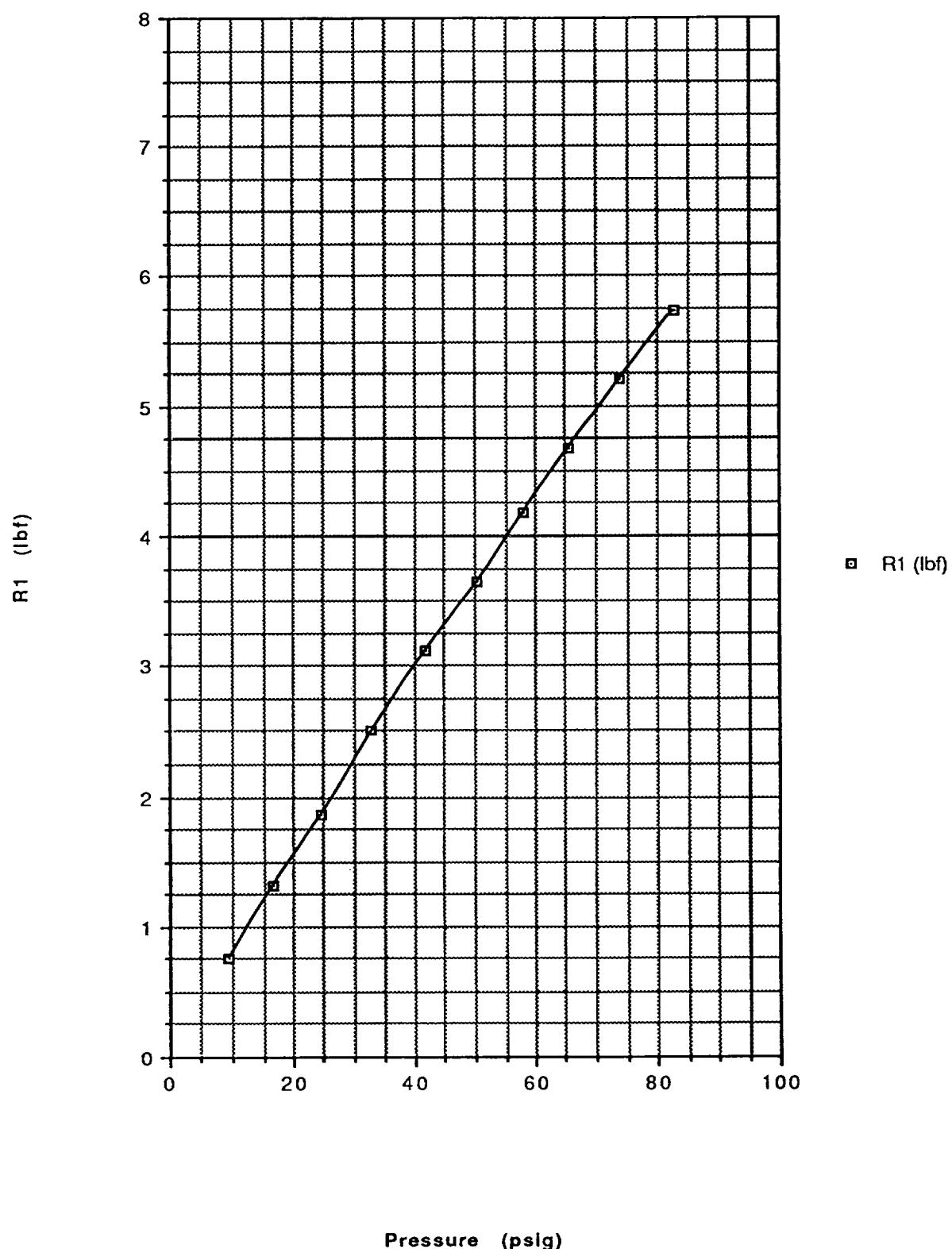
12/19/90 Straight



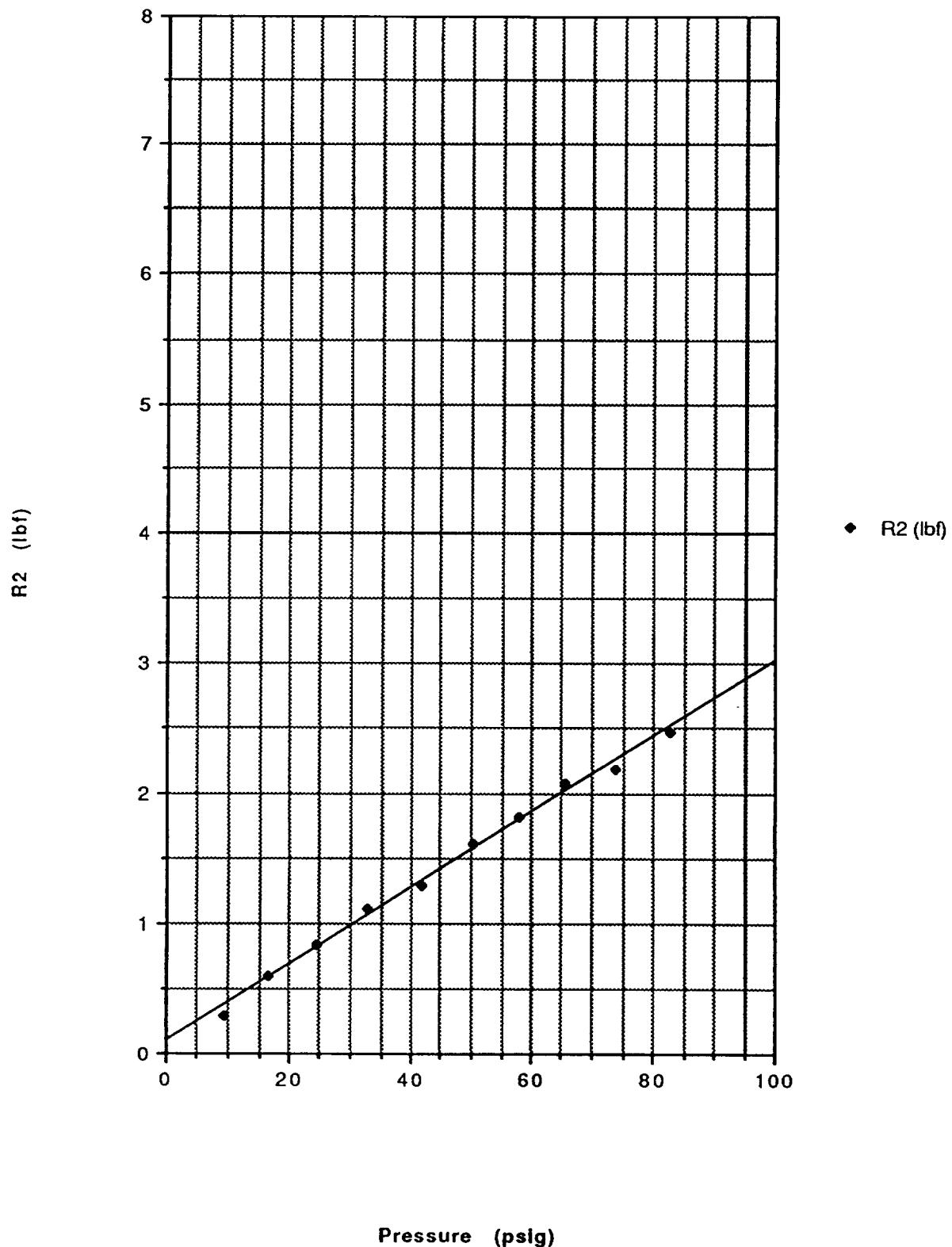
## APPENDIX B

5/24/91 STRAIGHT NOZZLE RUN

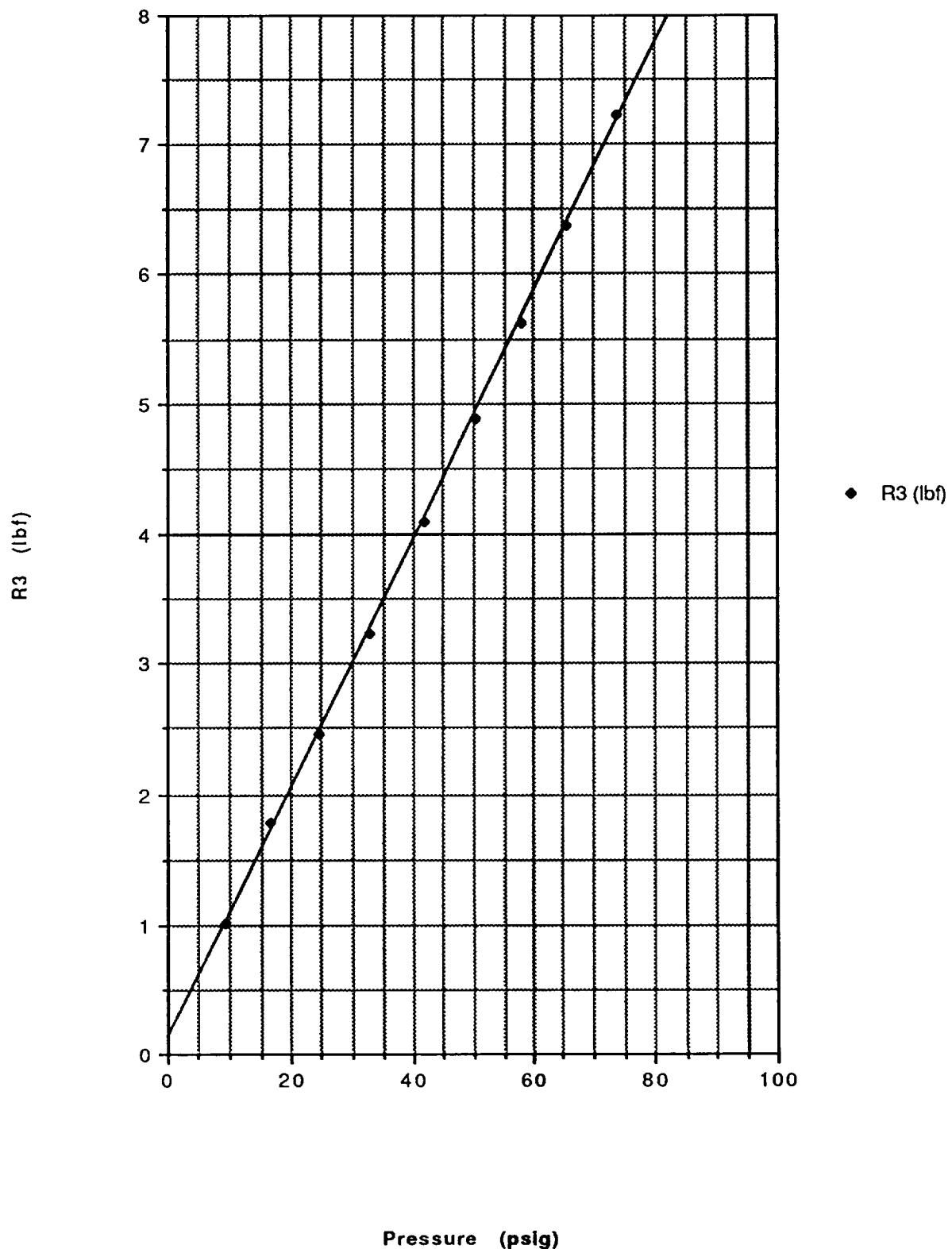
Data from "5/24/91 straight #2"



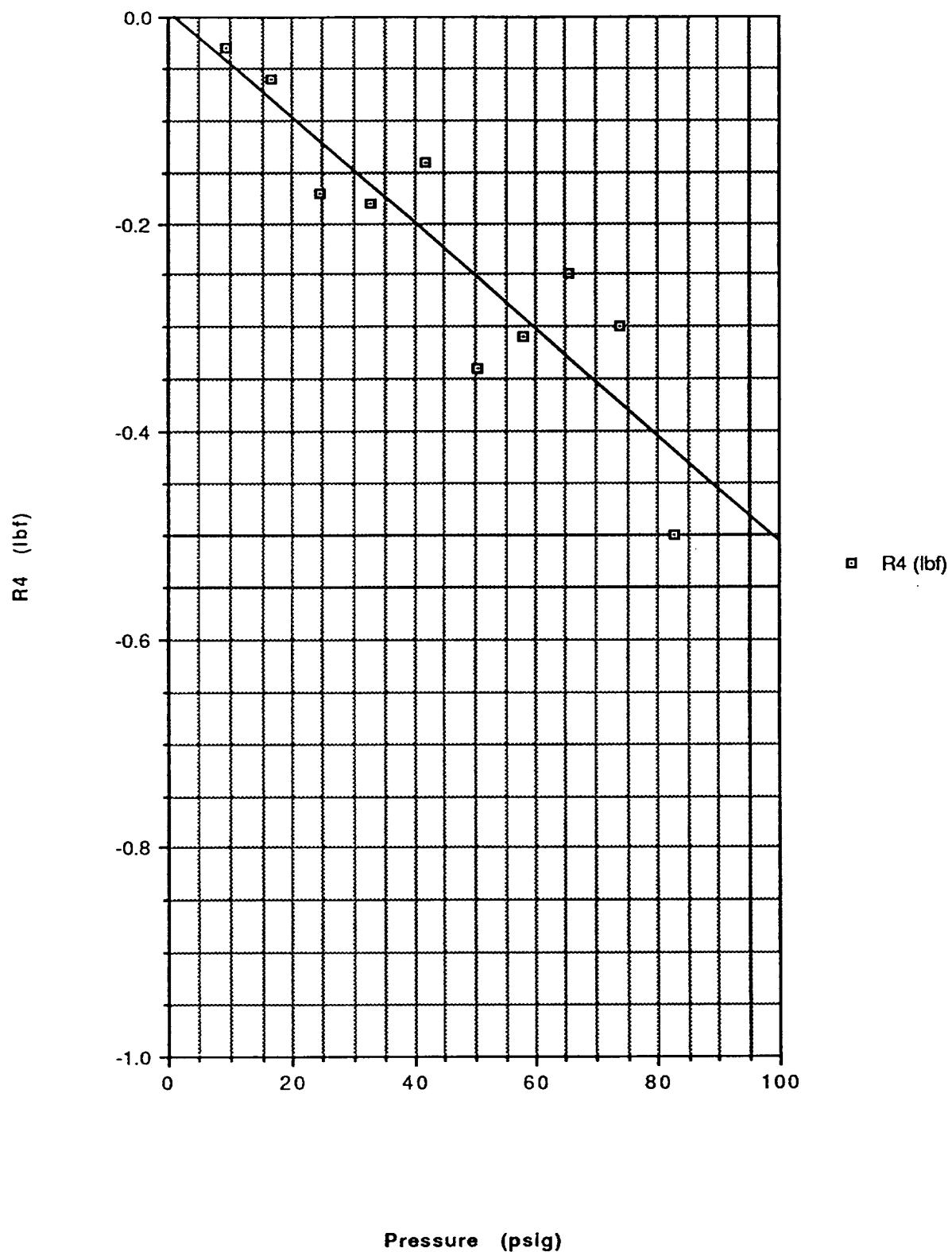
Data from "5/24/91 straight #2"



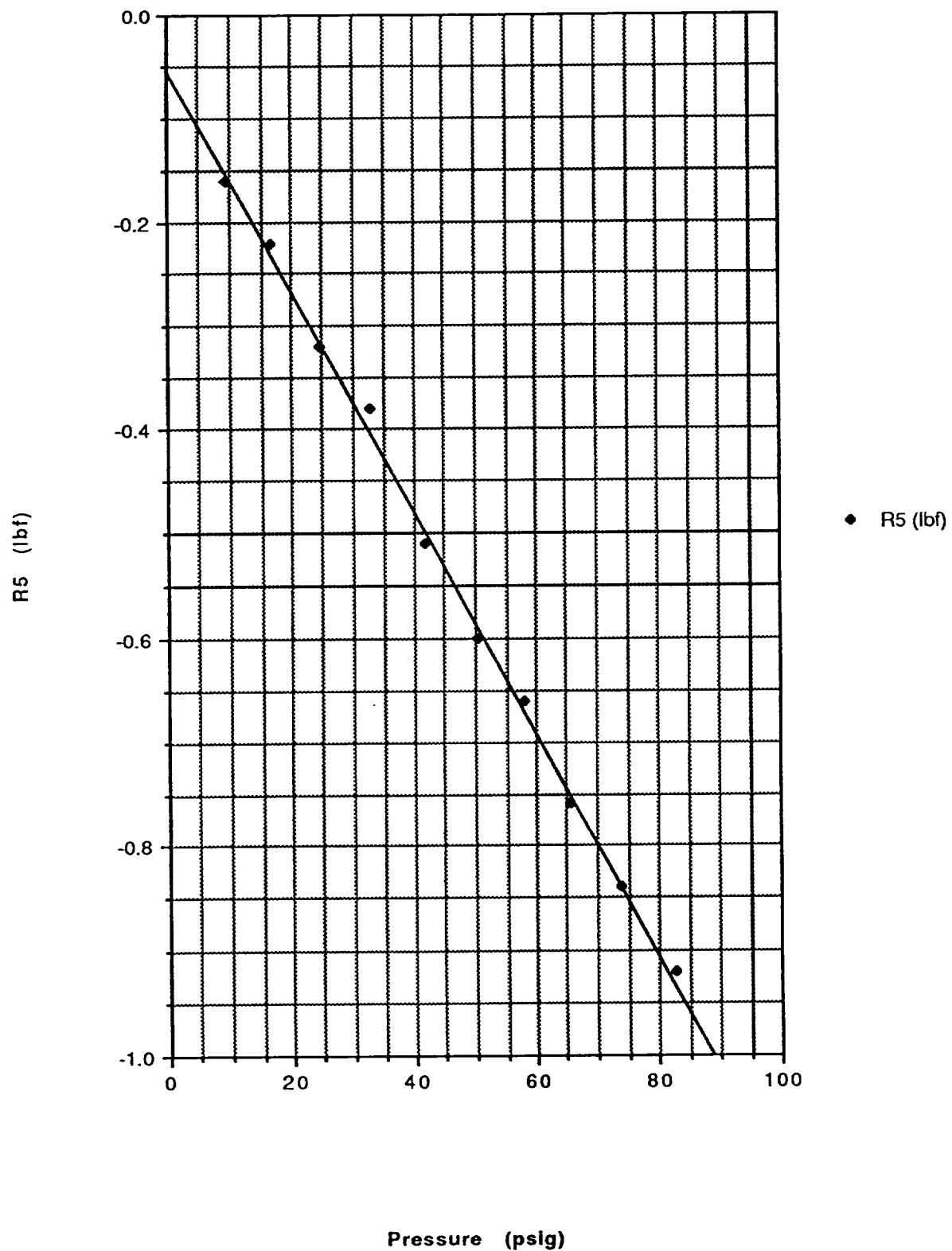
Data from "5/24/91 straight #2"



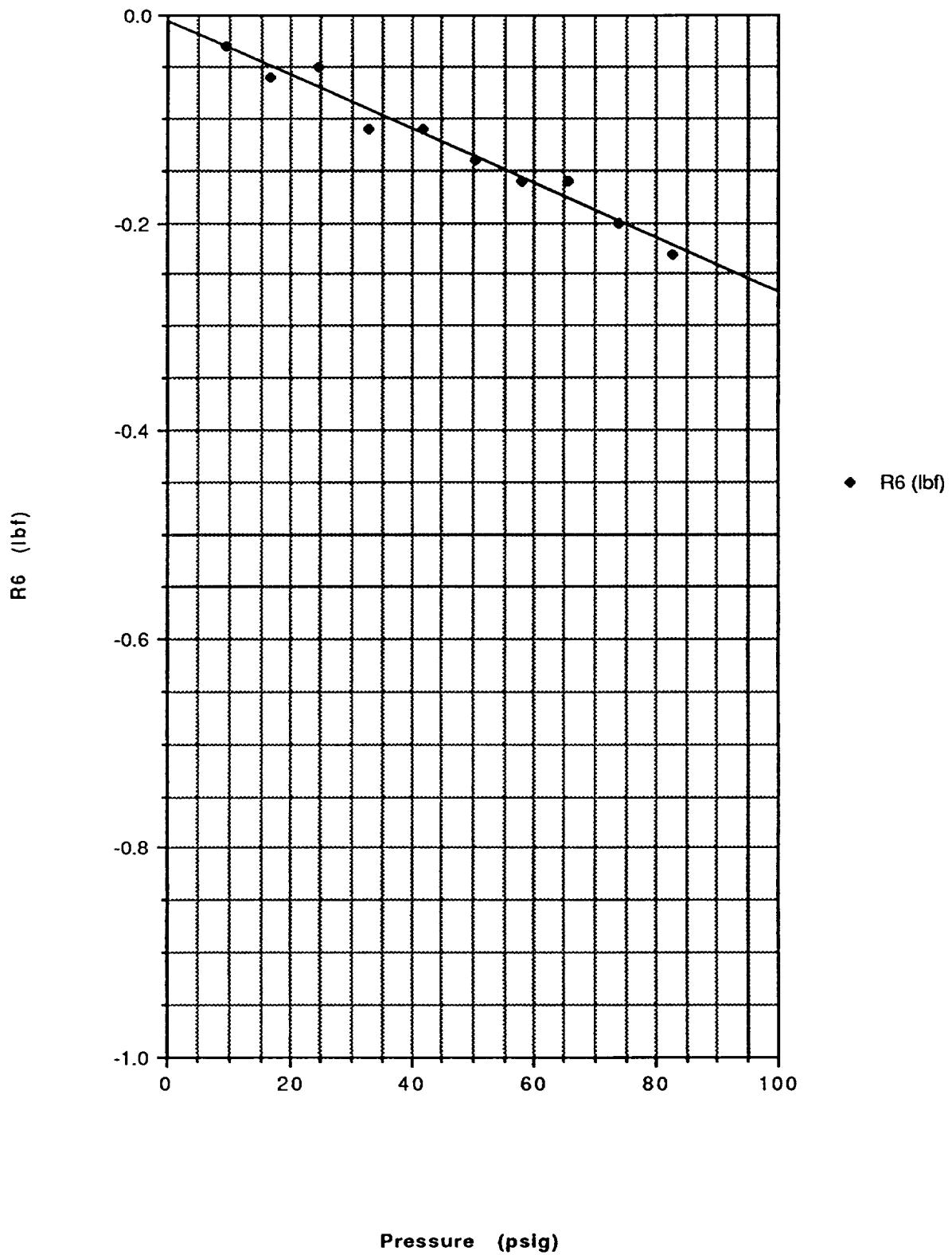
Data from "5/24/91 straight #2"



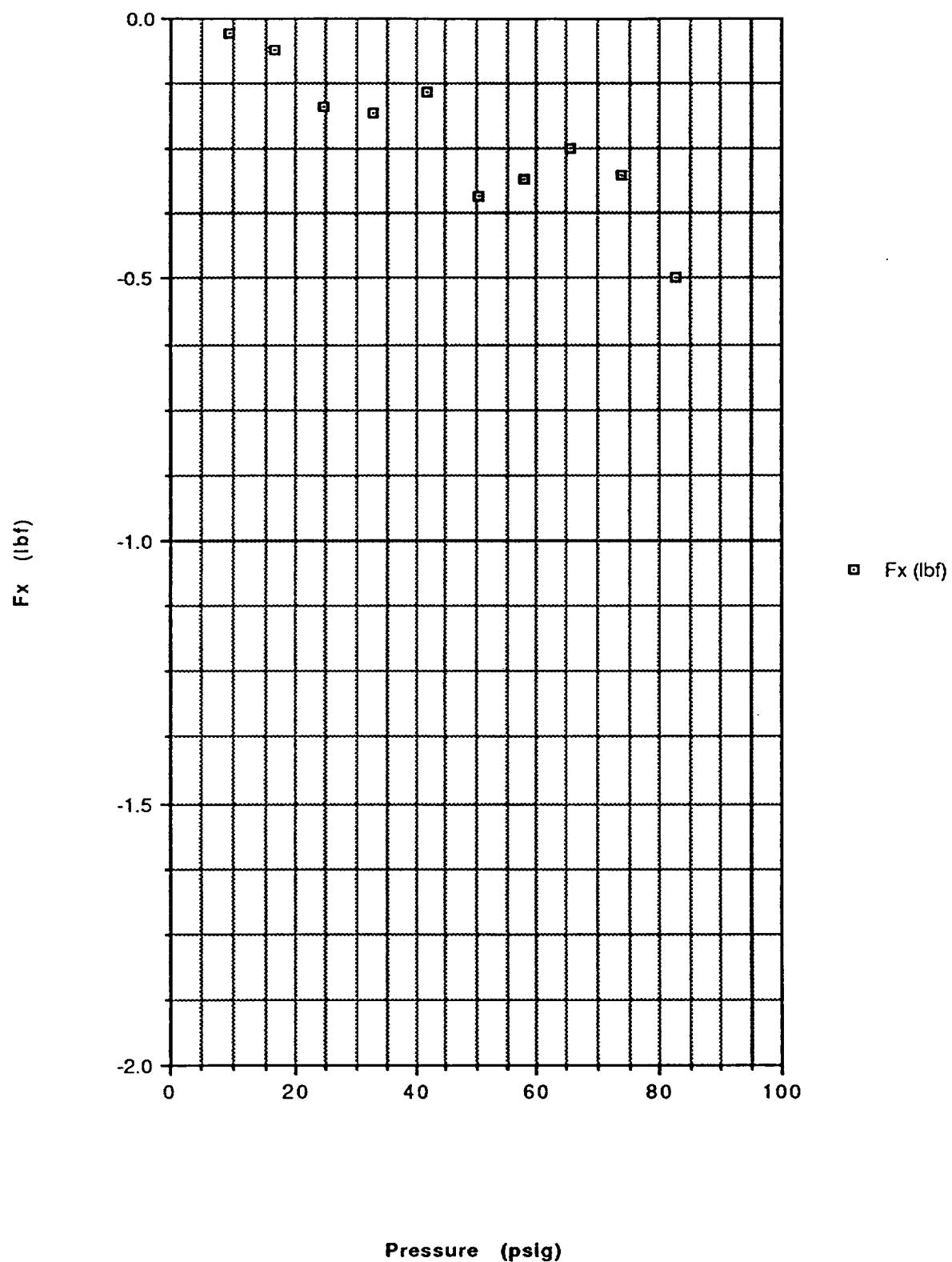
Data from "5/24/91 straight #2"



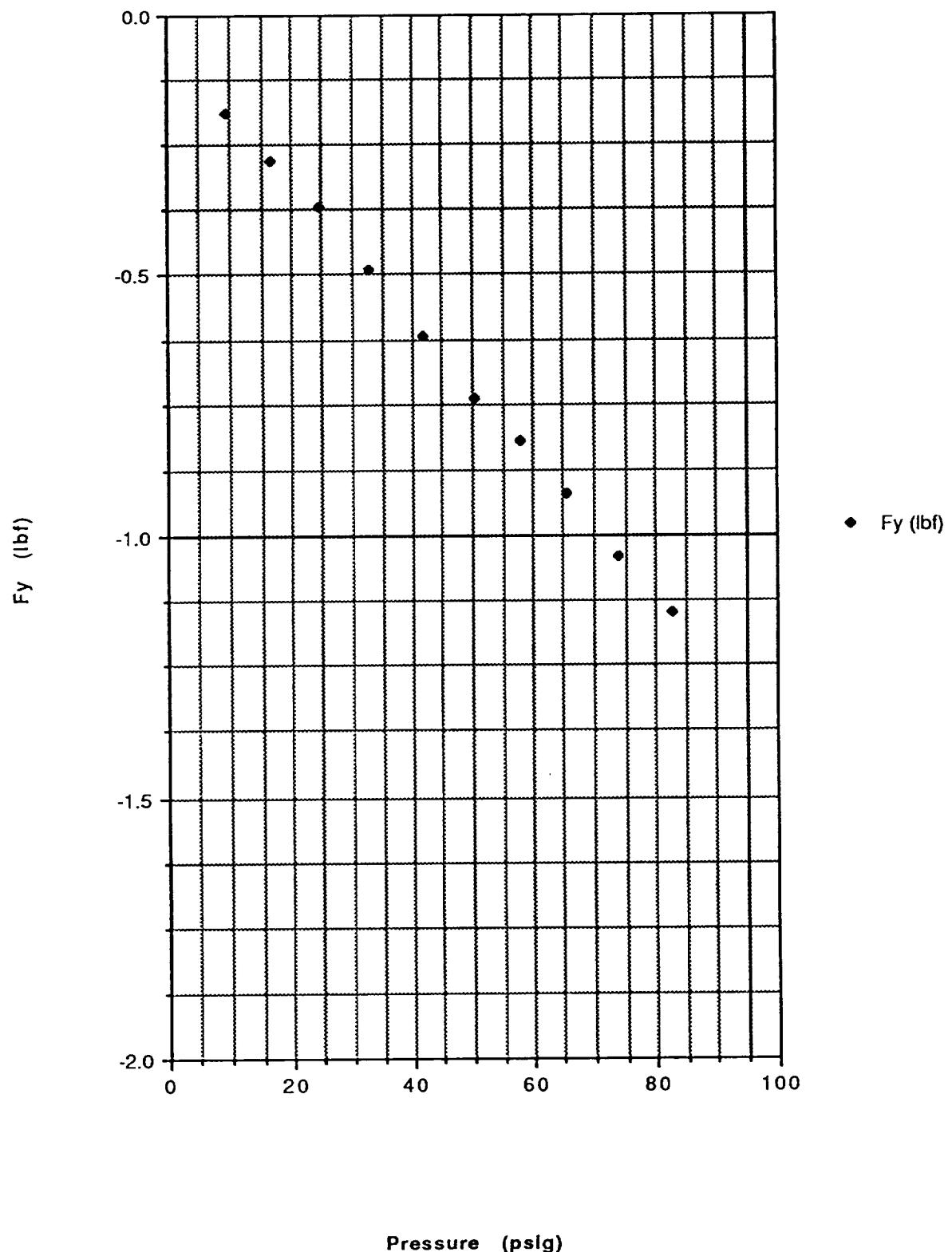
Data from "5/24/91 straight #2"



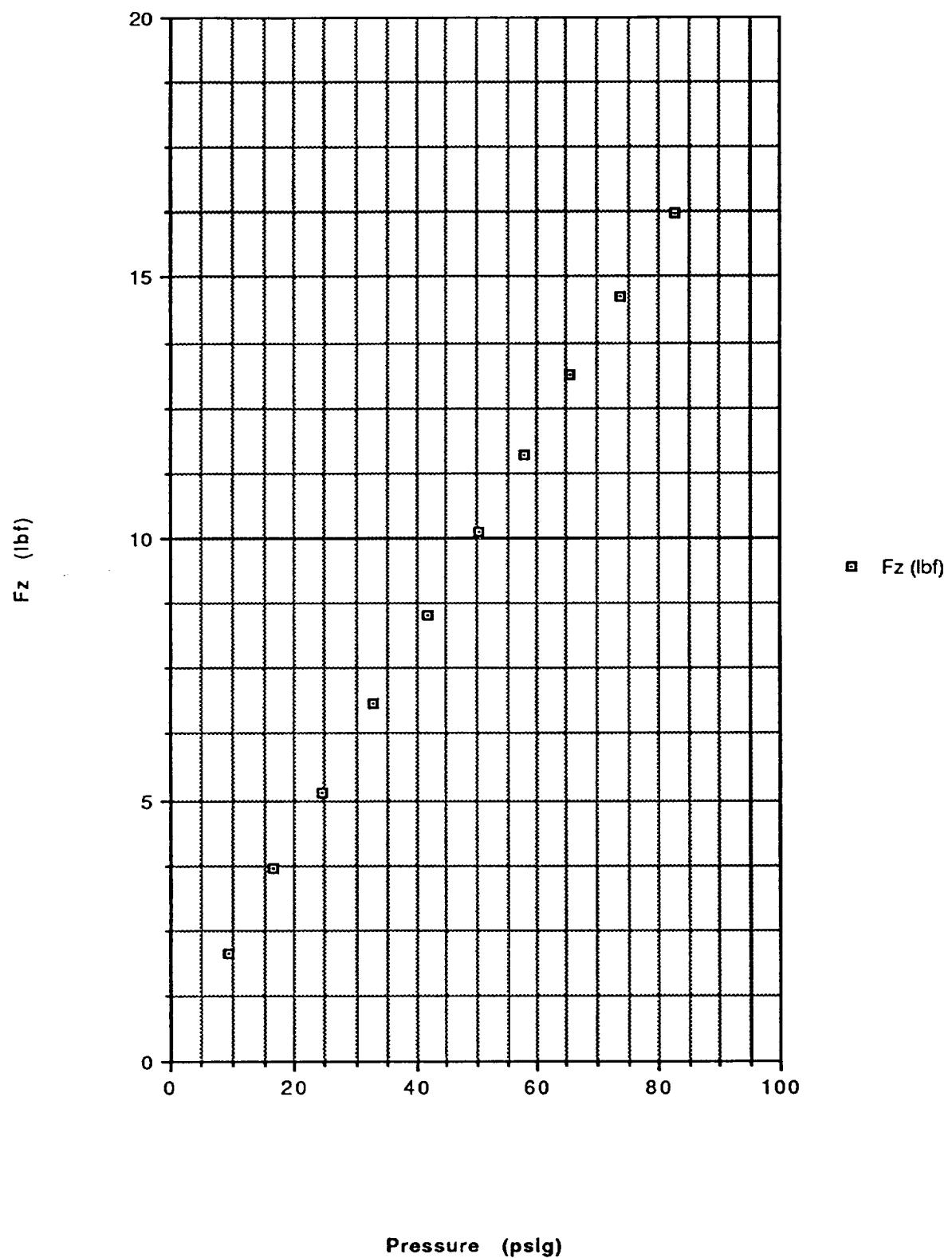
**Data from "5/24/91 straight #2"**



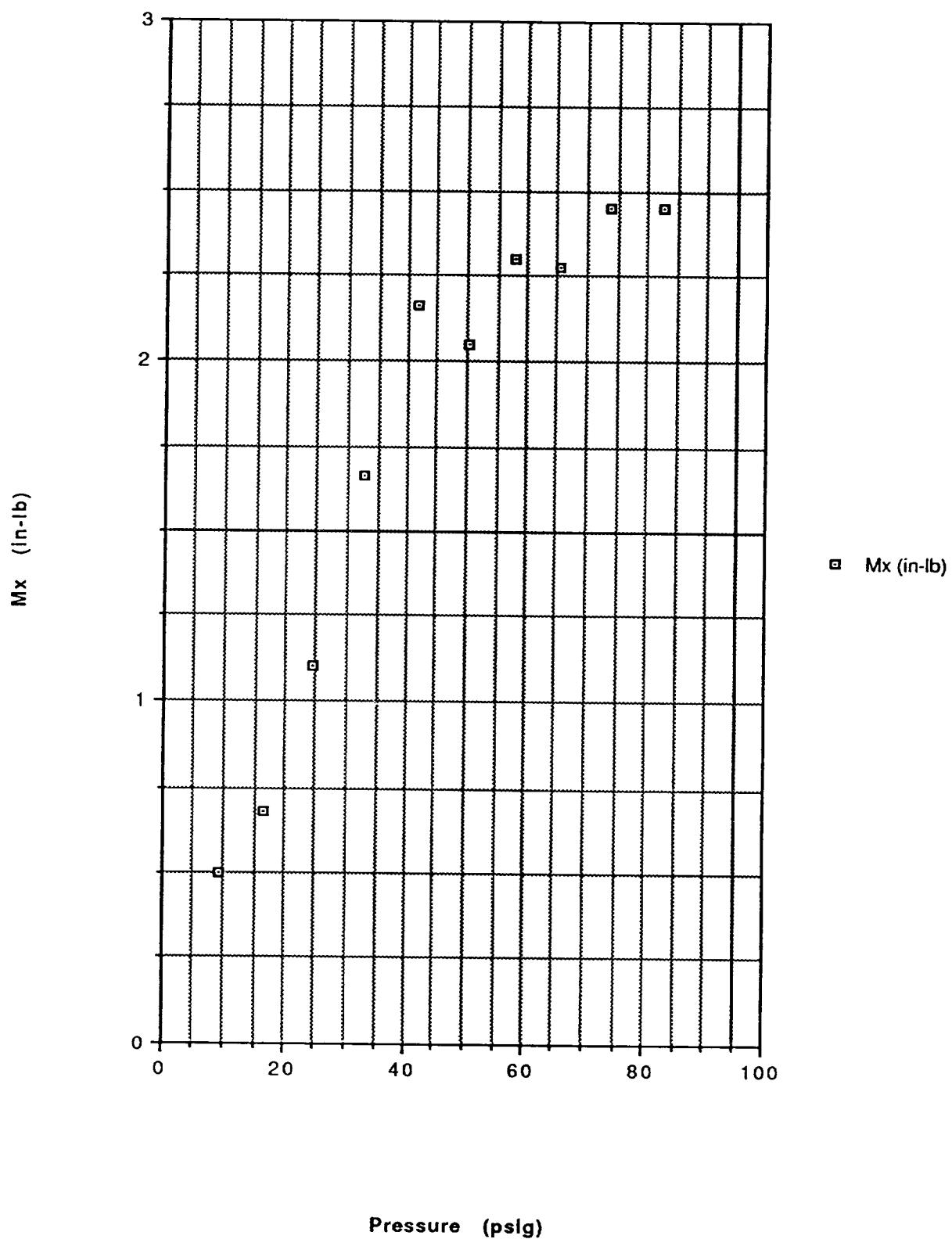
Data from "5/24/91 straight #2"



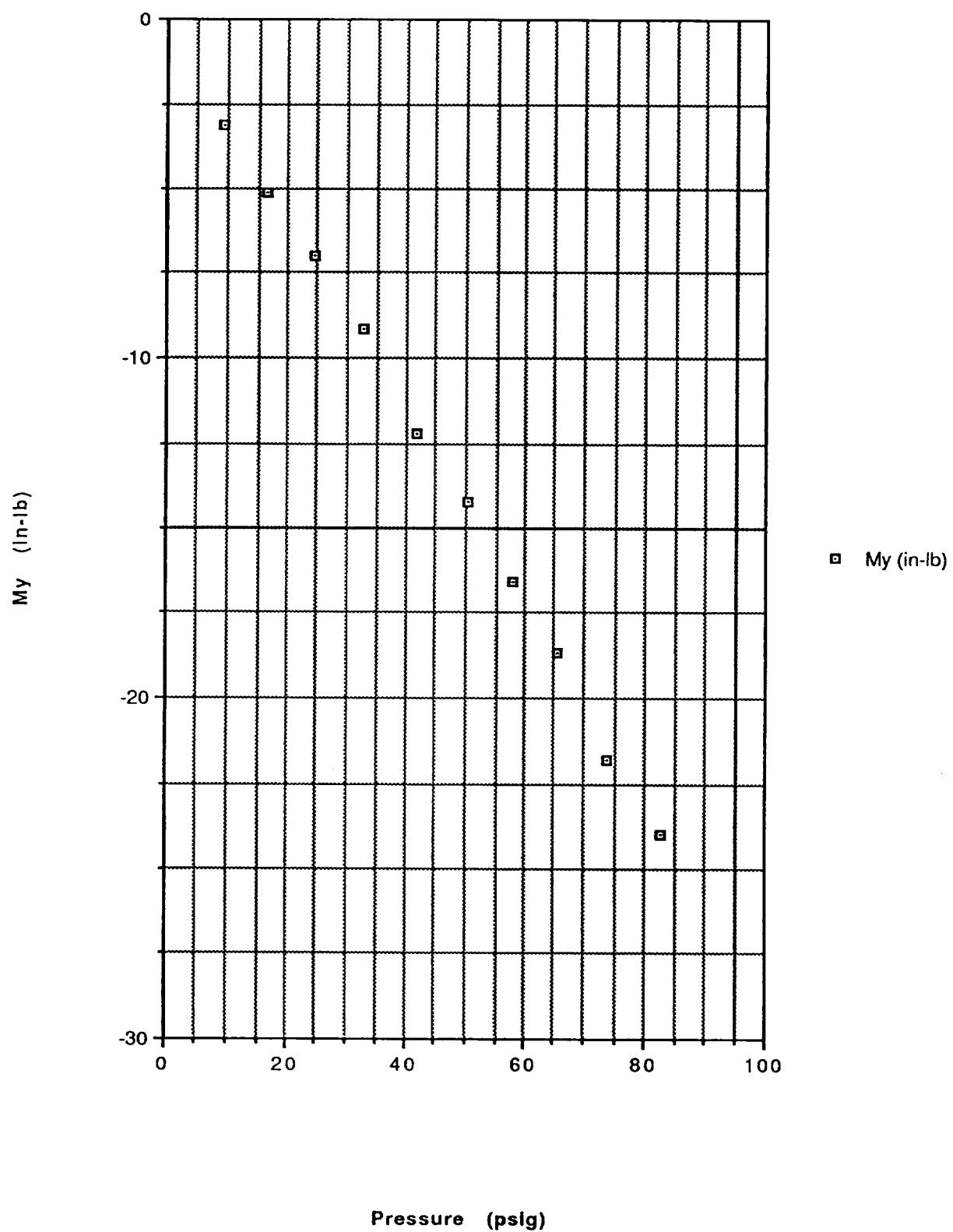
Data from "5/24/91 straight #2"



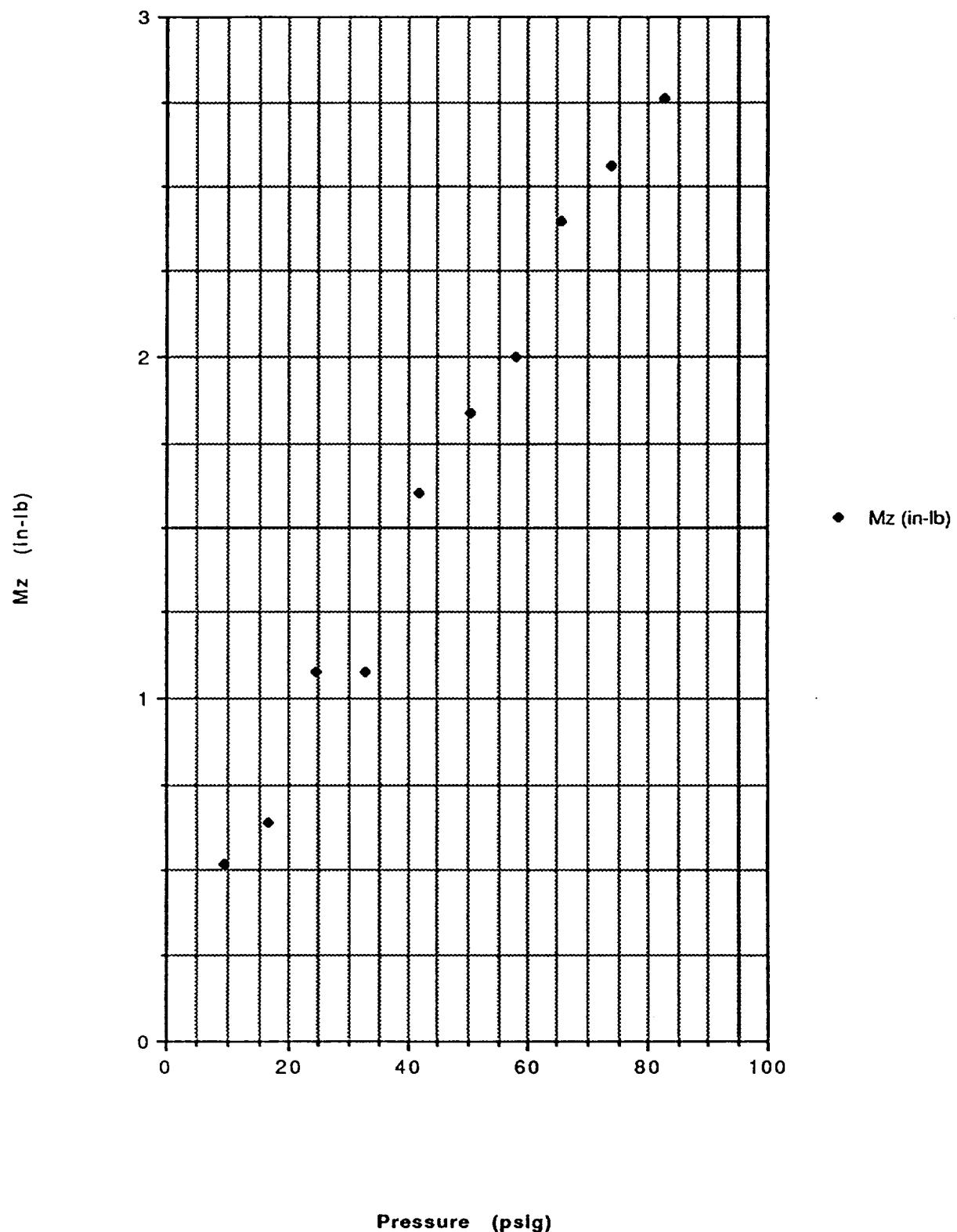
**Data from "5/24/91 straight #2"**



Data from "5/24/91 straight #2"



Data from "5/24/91 straight #2"



5/24/91 straight #2

Thu, Aug 15, 1991 2:31 PM

Pressure	Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (in-lb)	My (in-lb)	Mz (in-lb)
1 9.200	-0.030	-0.190	2.050	0.500	-3.120	0.520
2 16.600	-0.060	-0.280	3.690	0.680	-5.150	0.640
3 24.400	-0.170	-0.370	5.140	1.100	-7.010	1.080
4 32.900	-0.180	-0.490	6.840	1.660	-9.180	1.080
5 41.700	-0.140	-0.620	8.500	2.160	-12.210	1.600
6 50.400	-0.340	-0.740	10.130	2.050	-14.200	1.840
7 57.900	-0.310	-0.820	11.620	2.300	-16.540	2.000
8 65.500	-0.250	-0.920	13.130	2.280	-18.660	2.400
9 73.700	-0.300	-1.040	14.620	2.450	-21.820	2.560
10 82.600	-0.500	-1.150	16.240	2.450	-23.990	2.760

5/24/91 straight #2

Thu, Aug 15, 1991 2:31 PM

R1 (lbf)	R2 (lbf)	R3 (lbf)	R4 (lbf)	R5 (lbf)	R6 (lbf)
0.750	0.290	1.010	-0.030	-0.160	-0.030
1.320	0.590	1.780	-0.060	-0.220	-0.060
1.860	0.830	2.450	-0.170	-0.320	-0.050
2.500	1.110	3.230	-0.180	-0.380	-0.110
3.120	1.280	4.100	-0.140	-0.510	-0.110
3.650	1.600	4.880	-0.340	-0.600	-0.140
4.180	1.810	5.630	-0.310	-0.660	-0.160
4.680	2.070	6.380	-0.250	-0.760	-0.160
5.200	2.190	7.230	-0.300	-0.840	-0.200
5.740	2.480	8.020	-0.500	-0.920	-0.230

## APPENDIX C

8/8/91 DEAD WEIGHT TEST

VERTICAL VIBRATION CHECK

WEIGHT = ~~1680,5~~  
1680,5 g

P<sub>1</sub> PSENUM

P<sub>2</sub> NOZZLES

453,6 g/L

PRESSURE INST

WEIGHT = 3,7048 L

PASS AVG

INITIAL READINGS

$$R_1 = 22.67$$

$$R_2 = -22.25$$

$$R_3 = 23.95$$

$$R_4 = -0.18$$

$$R_5 = 1.21$$

$$R_6 = 1.75$$

FINAL READINGS

$$23.89 = 1.22$$

$$-21.04 = 1.21$$

$$25.18 = 1.23$$

$$-0.18 = 0$$

$$1.21 = 0$$

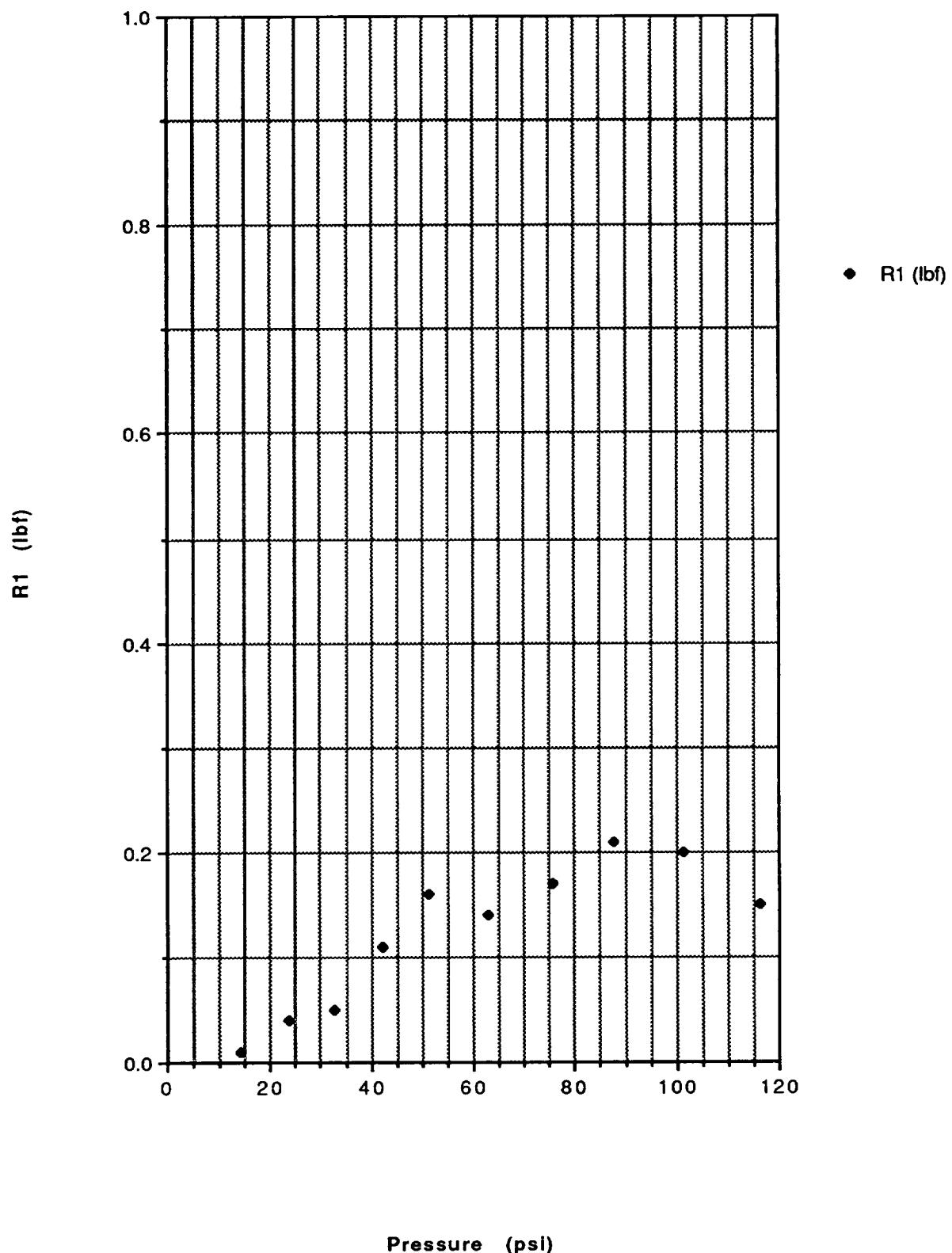
$$1.74 = .01$$

TOTAL WEIGHT = 3.66 L

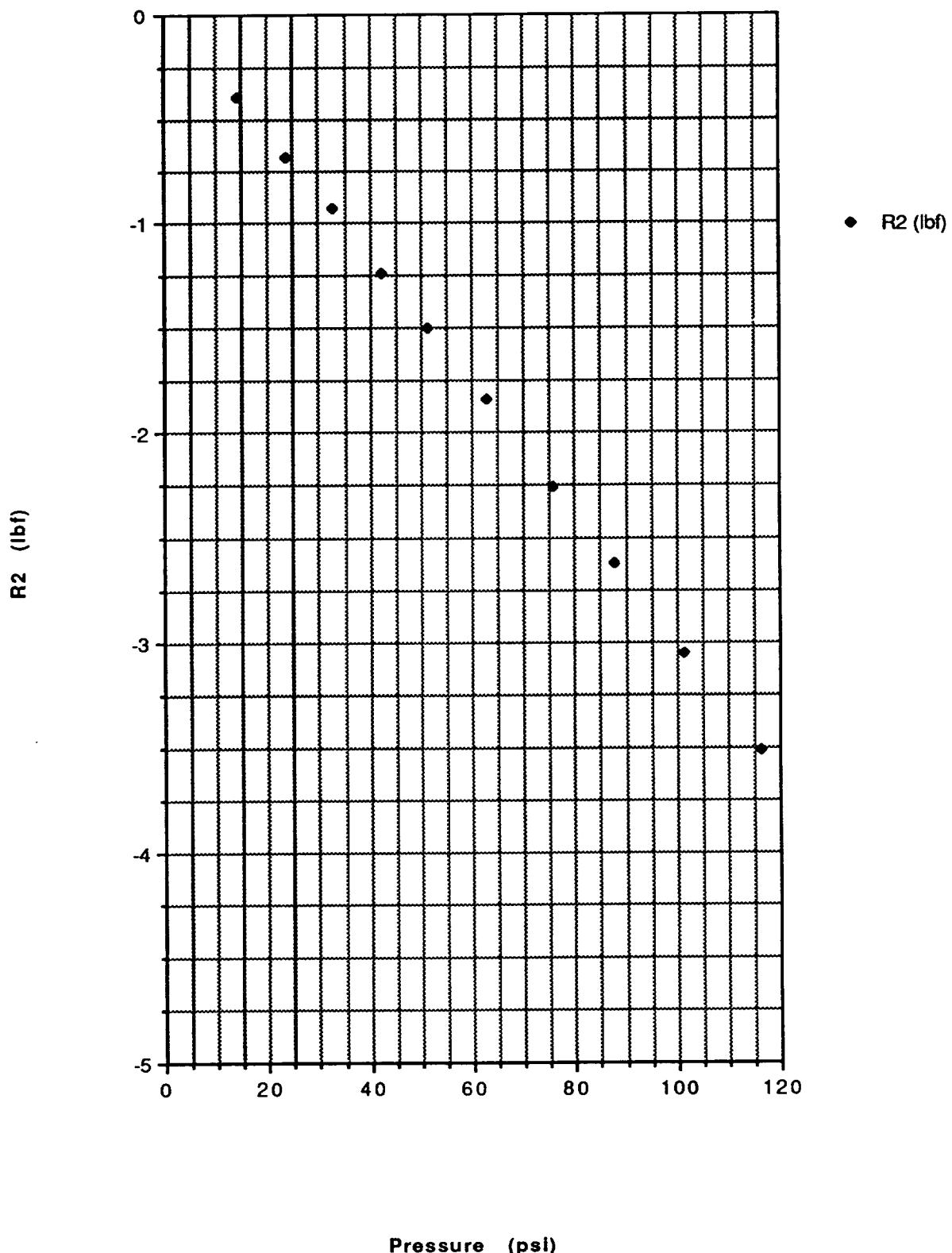
## APPENDIX D

8/8/91 PLUG NOZZLE RUN

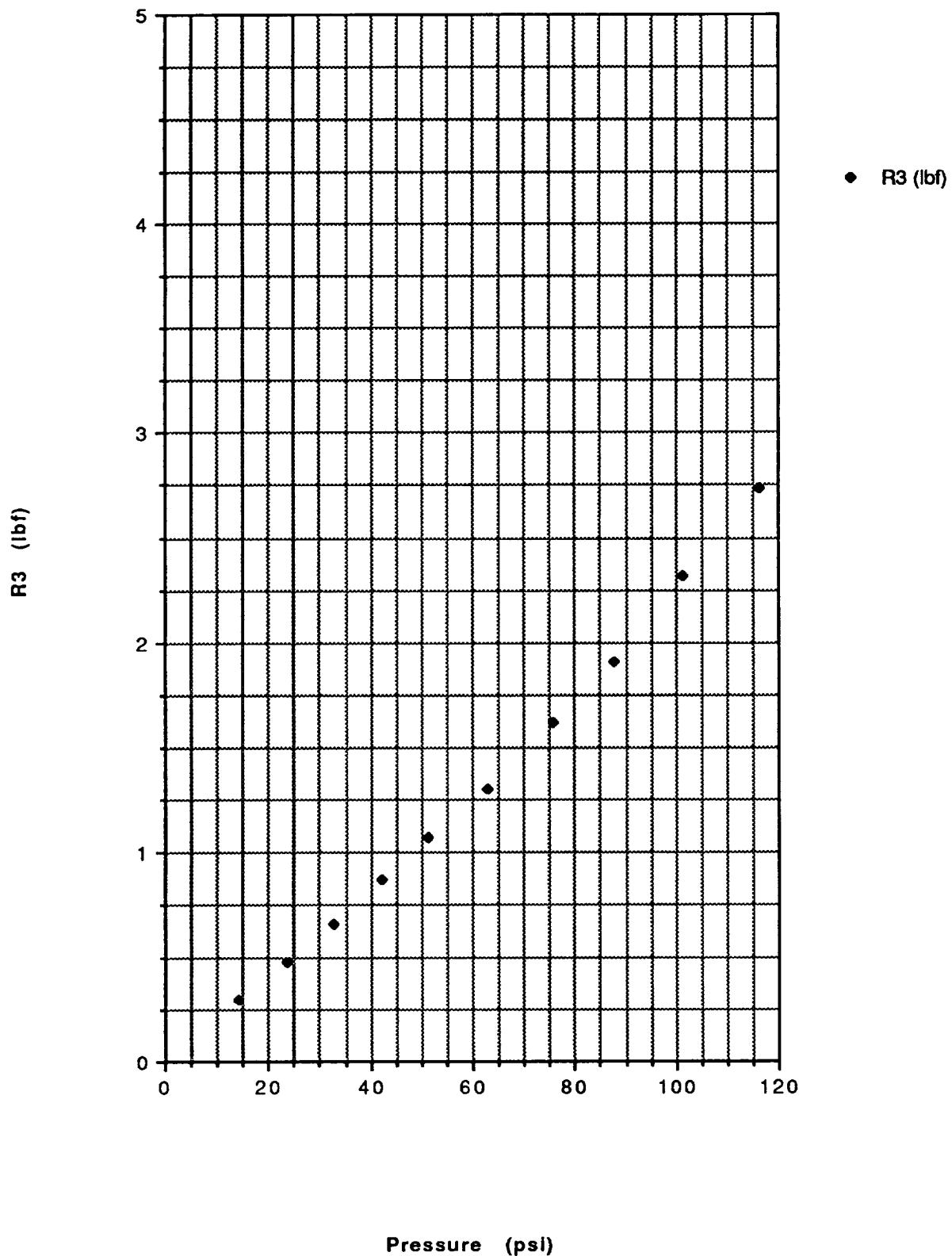
**Data from "8/8/91 Plug "**



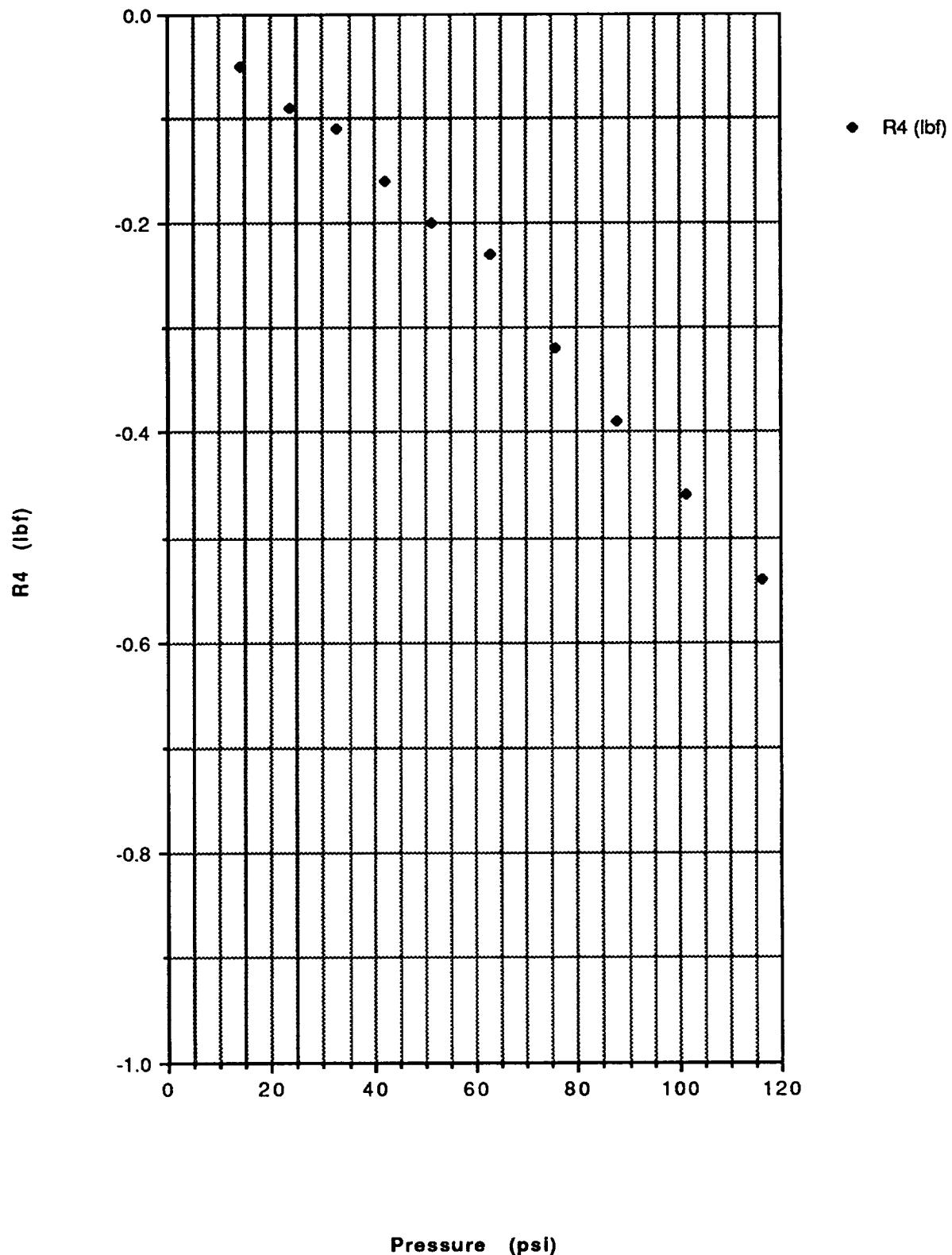
**Data from "8/8/91 Plug "**



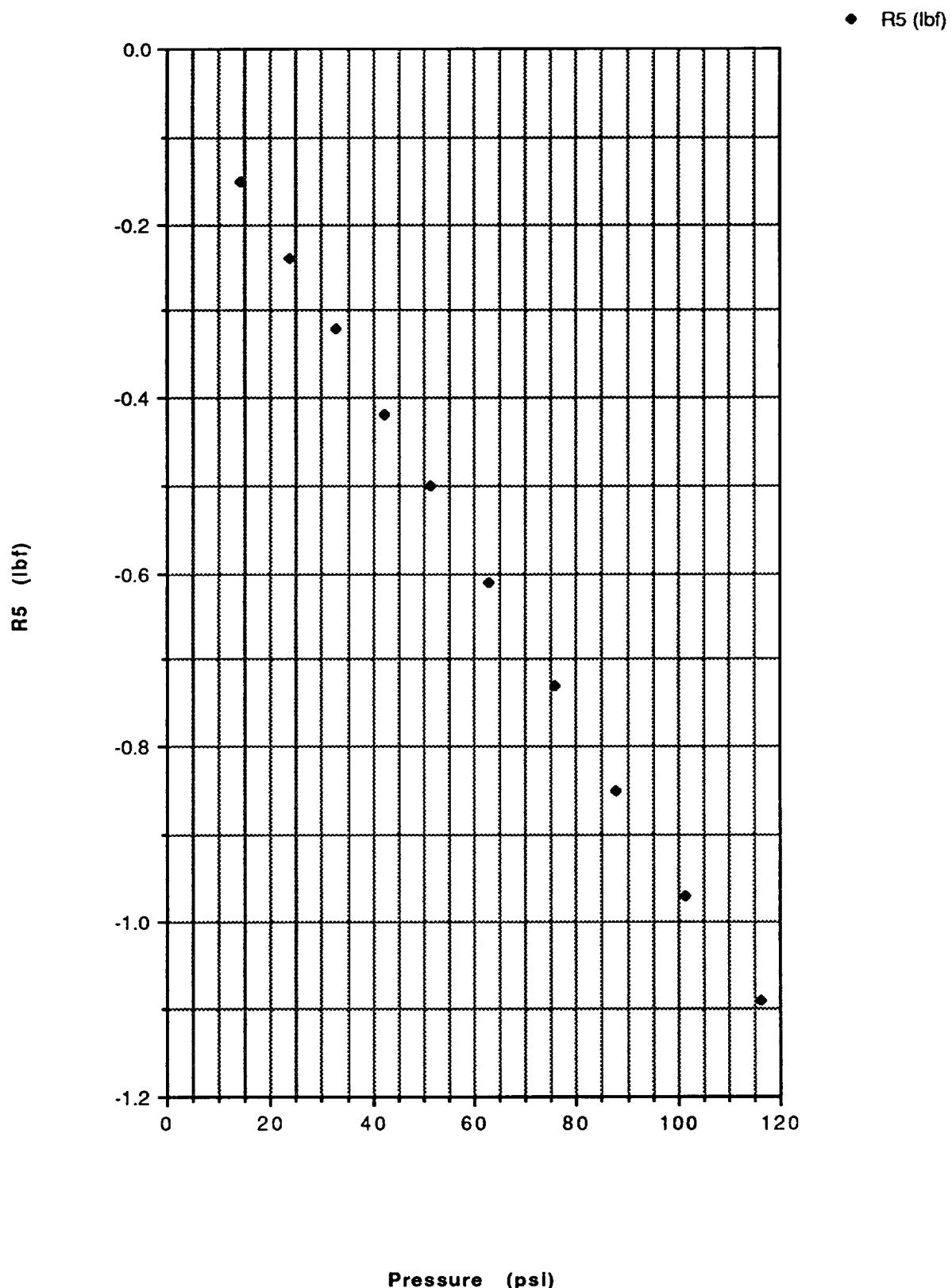
**Data from "8/8/91 Plug "**



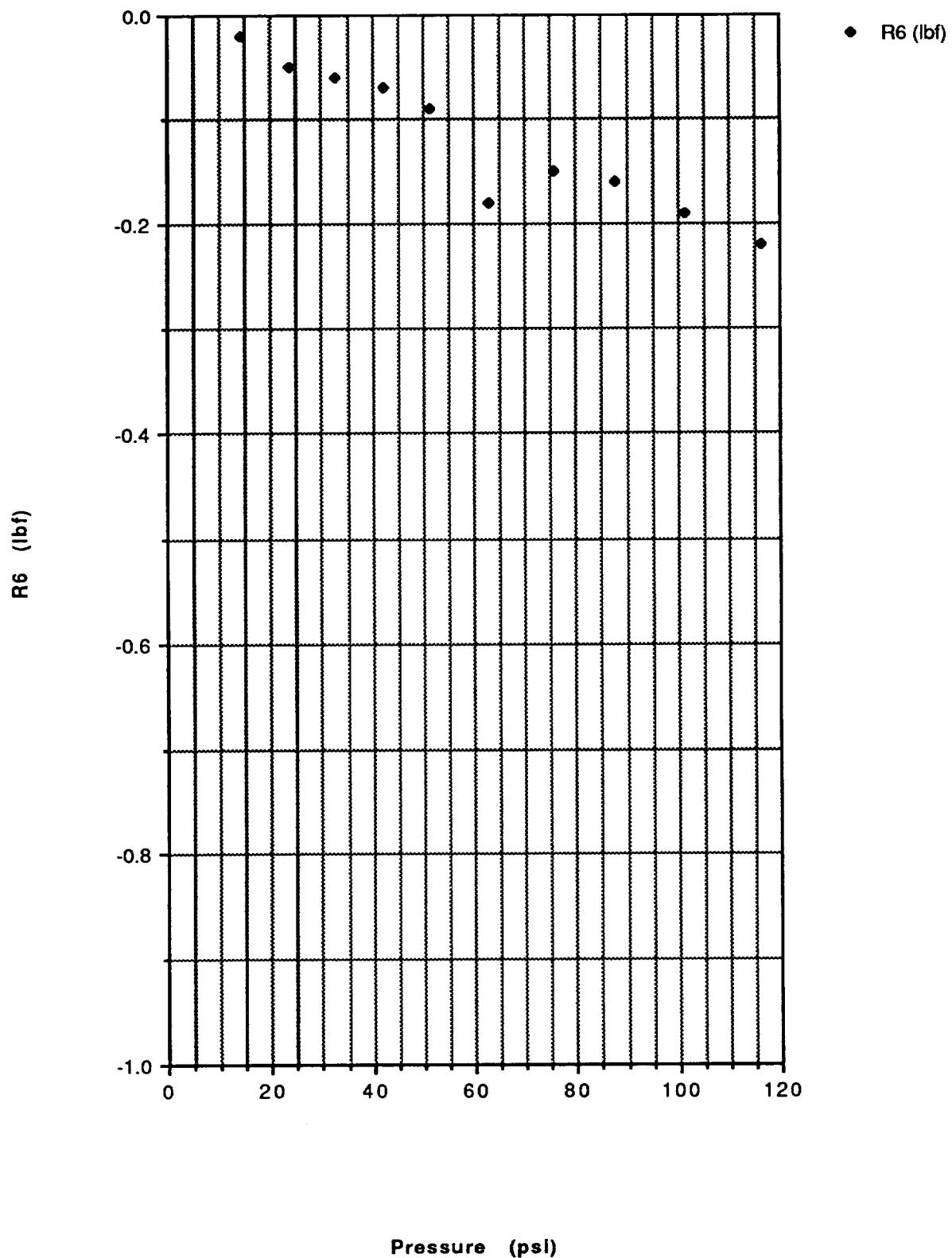
**Data from "8/8/91 Plug "**



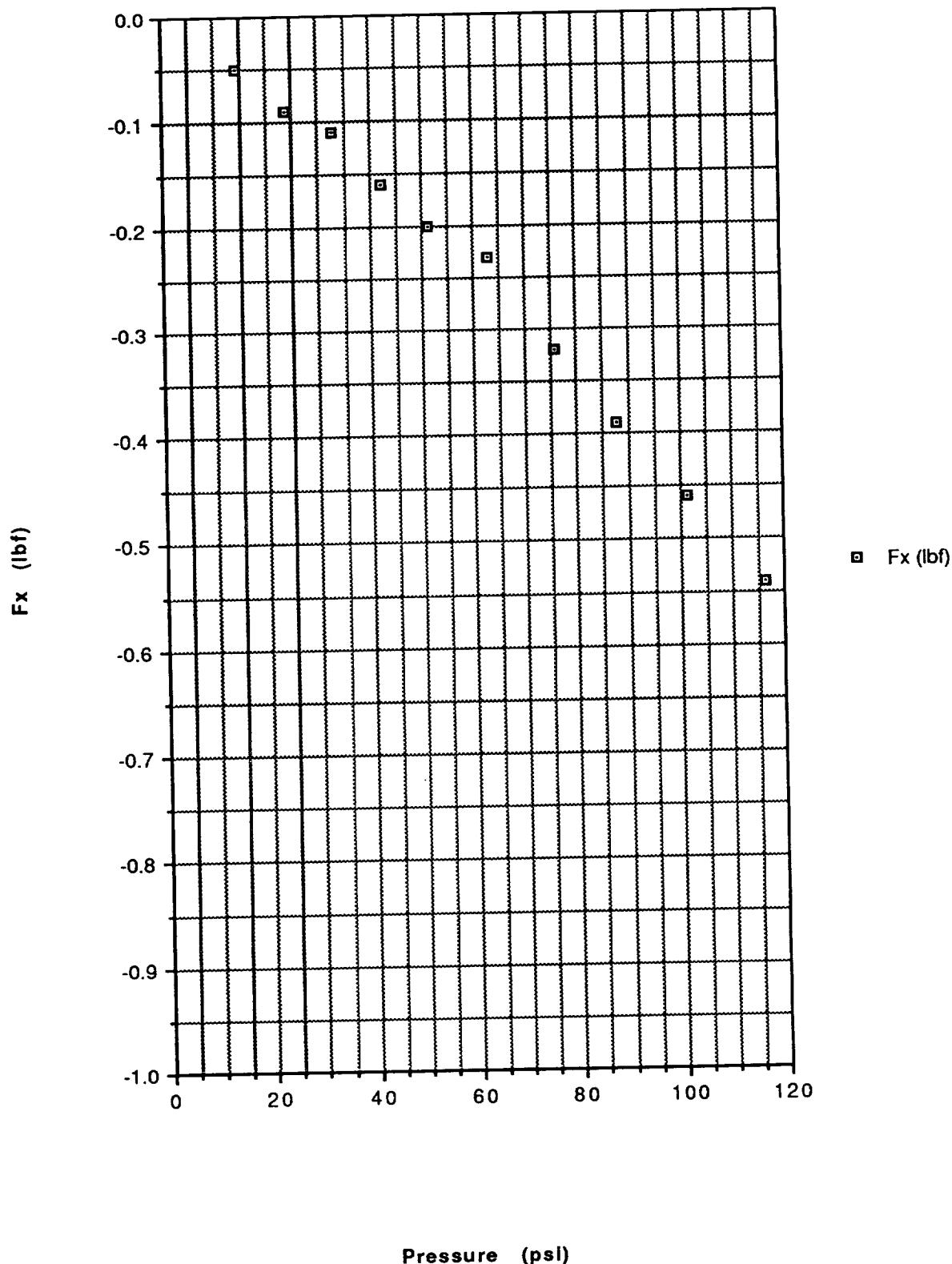
**Data from "8/8/91 Plug "**



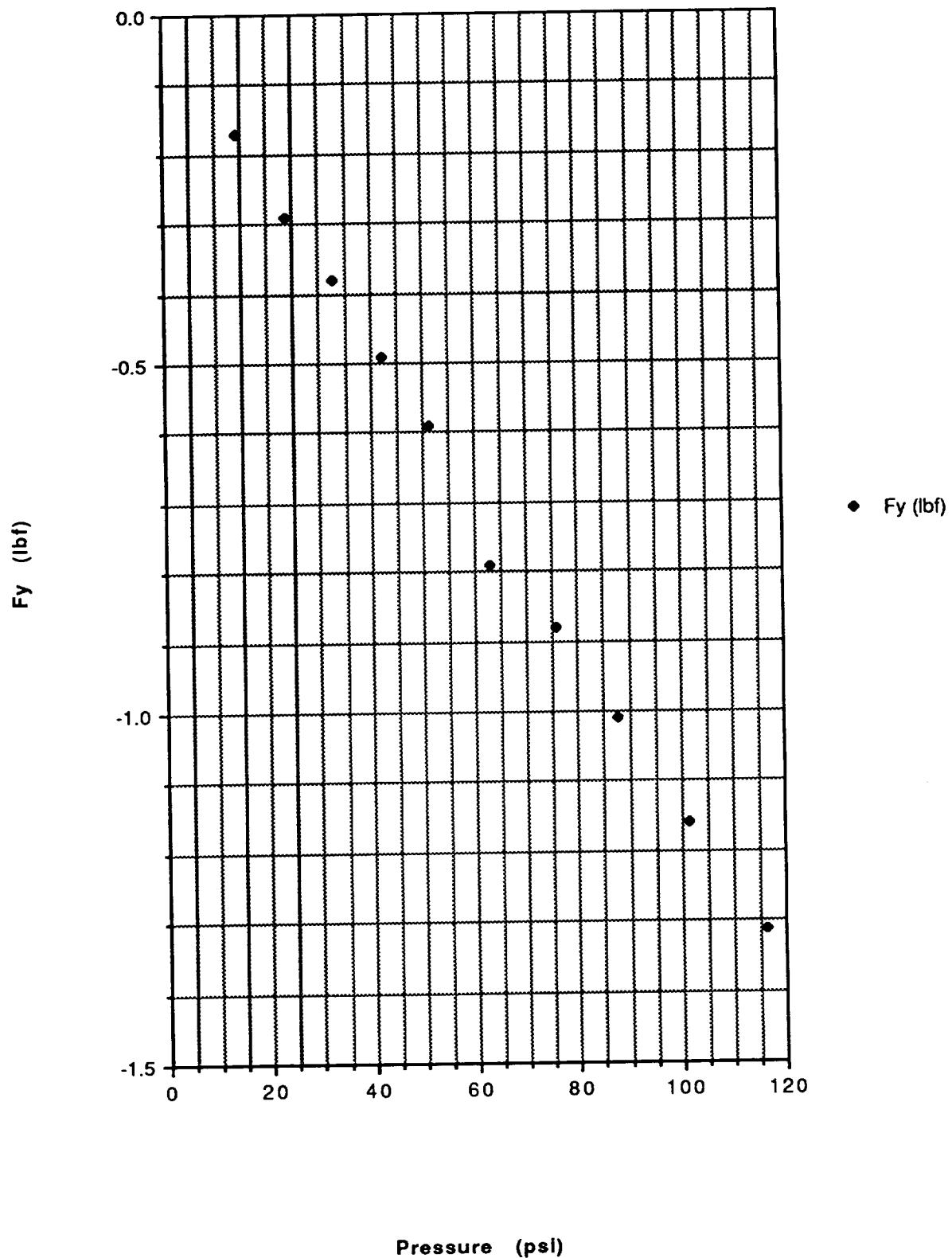
**Data from "8/8/91 Plug "**



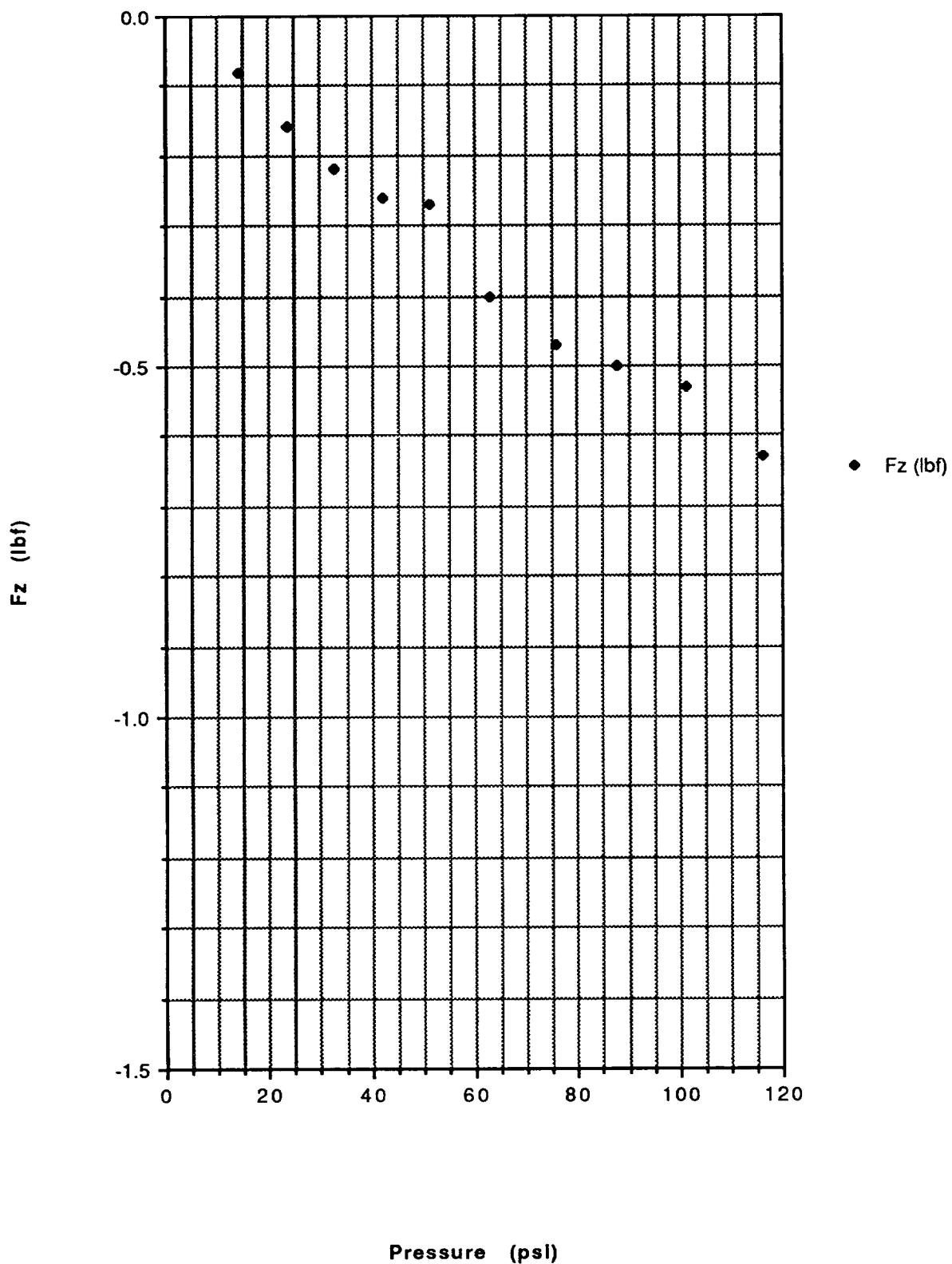
**Data from "8/8/91 Plug "**



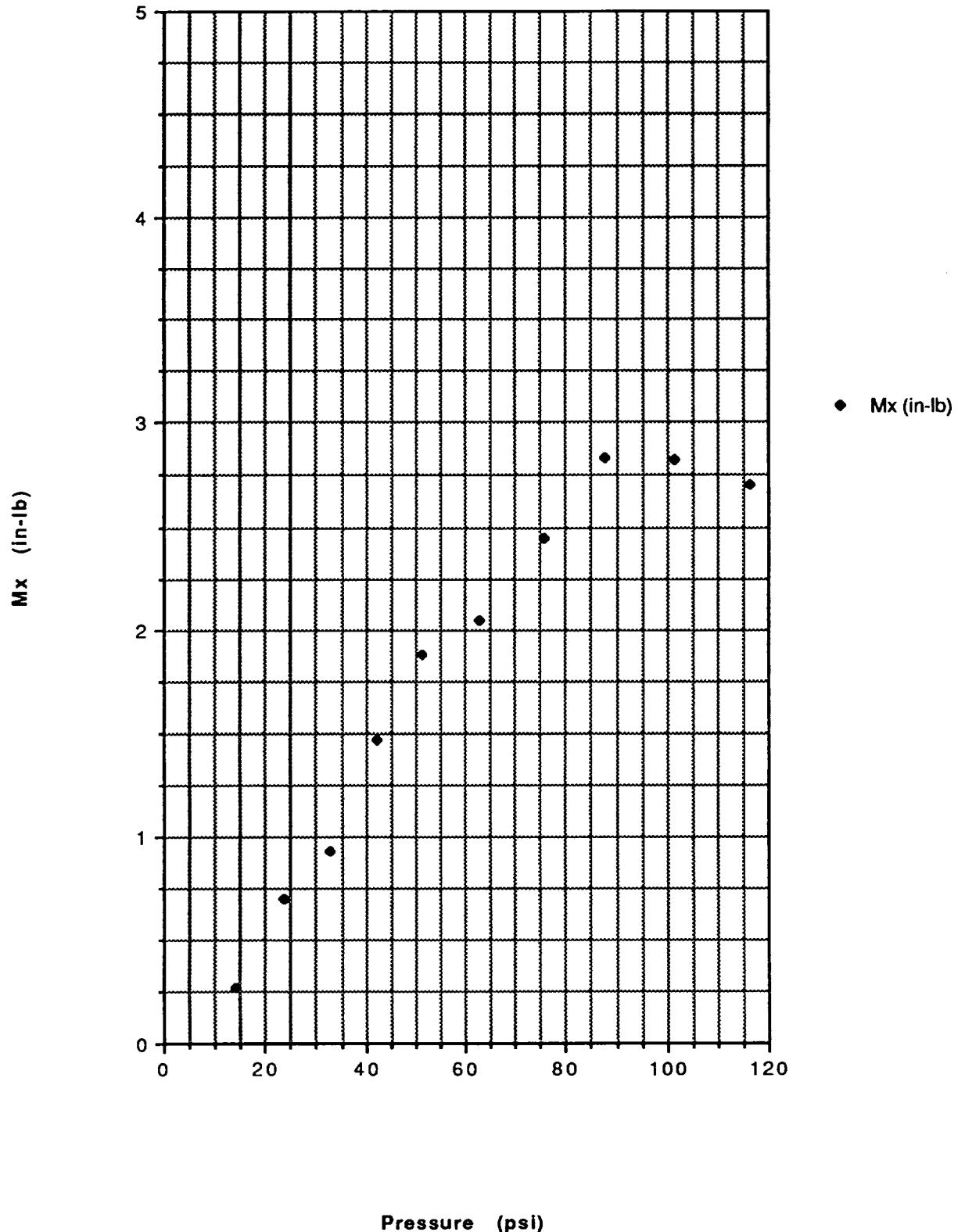
**Data from "8/8/91 Plug "**



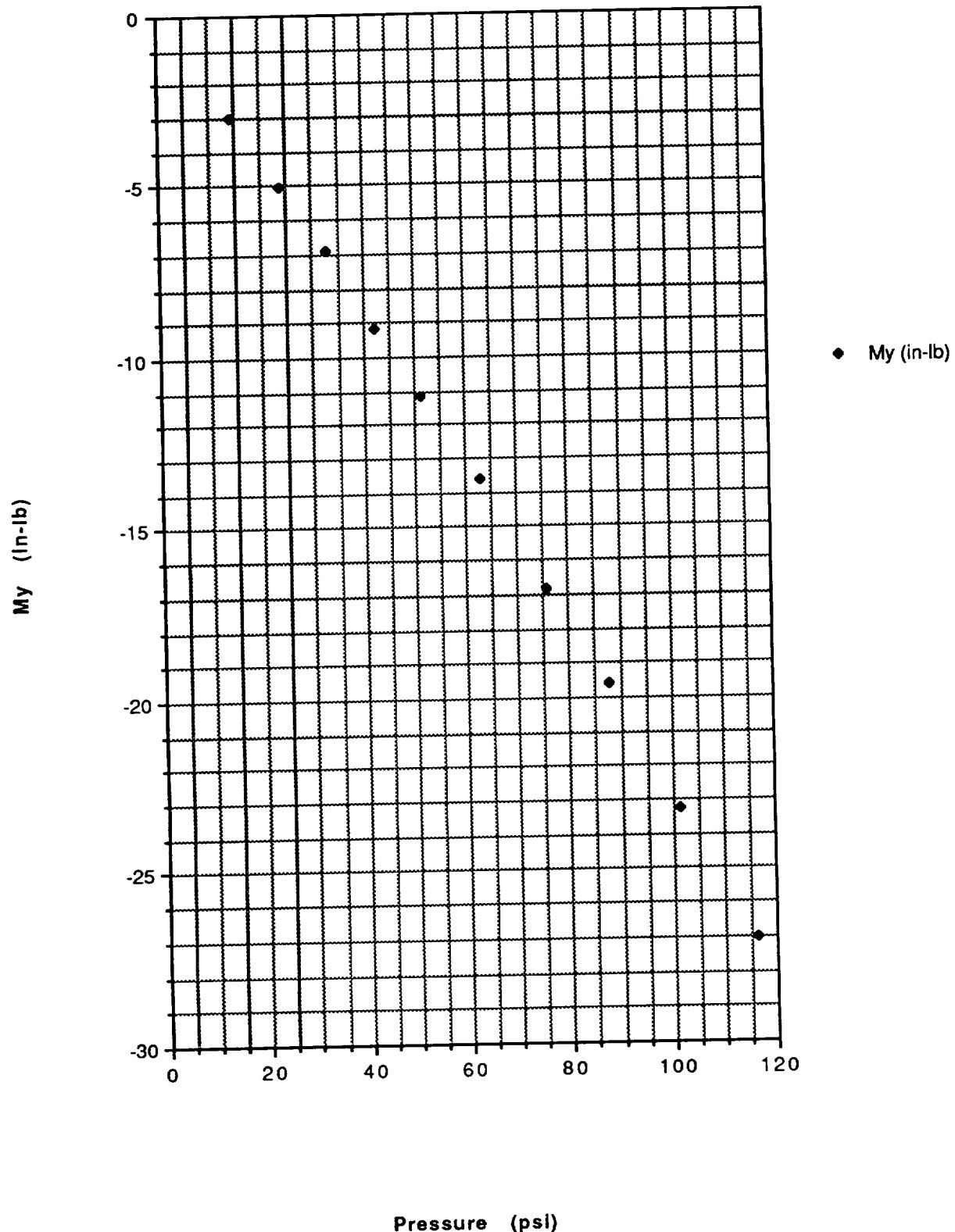
**Data from "8/8/91 Plug "**



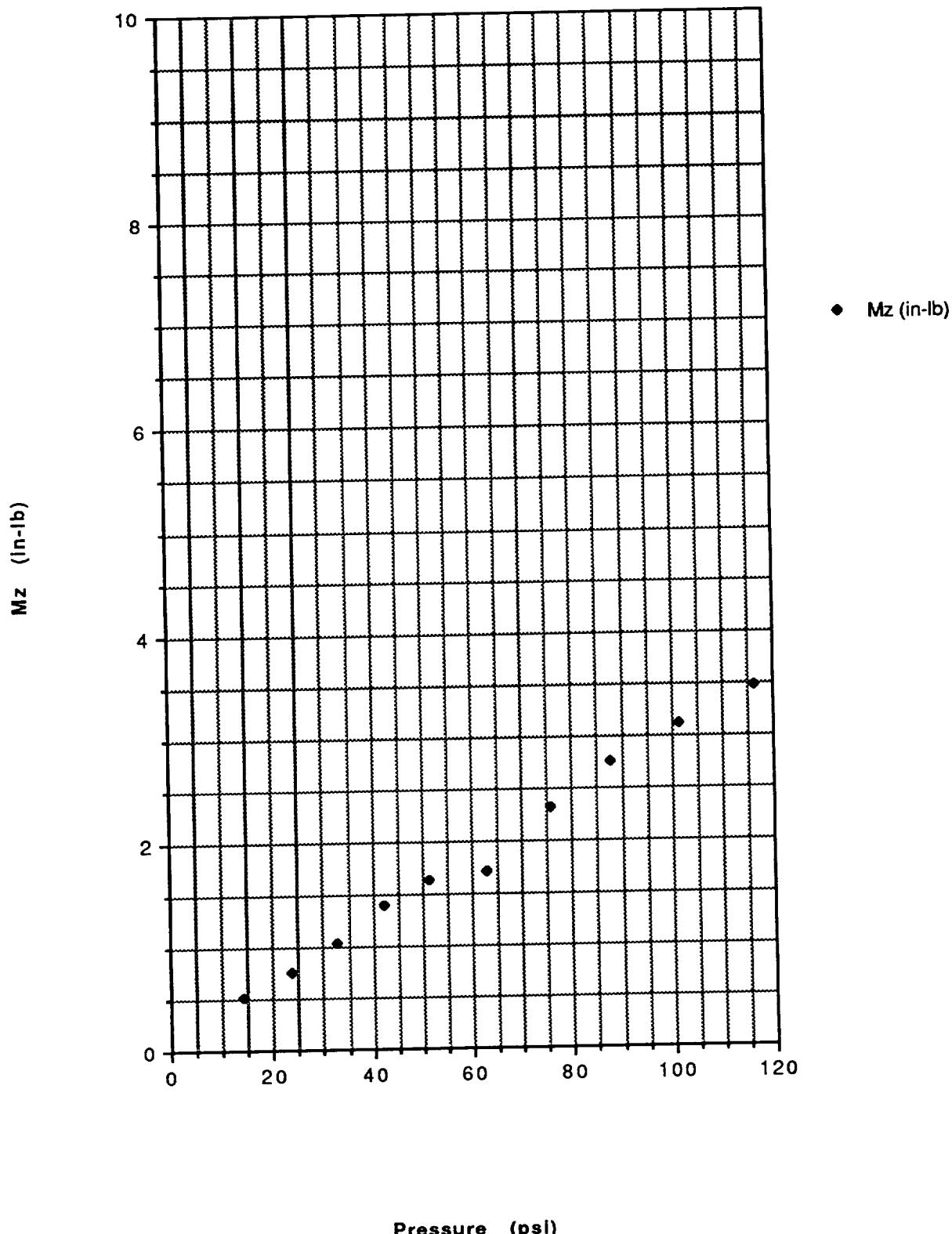
**Data from "8/8/91 Plug "**



**Data from "8/8/91 Plug "**



**Data from "8/8/91 Plug "**



8/8/91 Plug CG DATA

Thu, Aug 15, 1991 2:30 PM

R1 (lbf)	R2 (lbf)	R3 (lbf)	R4 (lbf)	R5 (lbf)	R6 (lbf)
0.010	-0.390	0.300	-0.050	-0.150	-0.020
0.040	-0.680	0.480	-0.090	-0.240	-0.050
0.050	-0.930	0.660	-0.110	-0.320	-0.060
0.110	-1.240	0.870	-0.160	-0.420	-0.070
0.160	-1.500	1.070	-0.200	-0.500	-0.090
0.140	-1.840	1.300	-0.230	-0.610	-0.180
0.170	-2.260	1.620	-0.320	-0.730	-0.150
0.210	-2.620	1.910	-0.390	-0.850	-0.160
0.200	-3.050	2.320	-0.460	-0.970	-0.190
0.150	-3.510	2.730	-0.540	-1.090	-0.220

8/8/91 Plug CG DATA

Thu, Aug 15, 1991 2:30 PM

Pressure (psi)	Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (in-lb)	My (in-lb)	Mz (in-lb)
14.100	-0.050	-0.170	-0.080	0.270	-2.990	0.520
23.600	-0.090	-0.290	-0.160	0.700	-5.020	0.760
32.700	-0.110	-0.380	-0.220	0.930	-6.880	1.040
42.200	-0.160	-0.490	-0.260	1.470	-9.140	1.400
51.200	-0.200	-0.590	-0.270	1.880	-11.130	1.640
62.700	-0.230	-0.790	-0.400	2.050	-13.600	1.720
75.700	-0.320	-0.880	-0.470	2.450	-16.800	2.320
87.600	-0.390	-1.010	-0.500	2.830	-19.610	2.760
101.500	-0.460	-1.160	-0.530	2.820	-23.250	3.120
116.100	-0.540	-1.310	-0.630	2.700	-27.020	3.480

A 300

# 1

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:38 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.9	psig		
15*Press1	-2.8	psig		
16*Press2	-1.9	psig		
17*R1	22.62	lbf		
18*R2	-22.64	lbf		
19*R3	23.52	lbf		
20*R4	0.01	lbf		
21*R5	1.12	lbf		
22*R6	1.51	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:39 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
Pressure 1	11.3	psig		
Pressure 2	12.2	psig		
15*Press1	11.4	psig		
16*Press2	12.3	psig		
17*R1	22.63	lbf		
18*R2	-23.03	lbf		
19*R3	23.82	lbf		
20*R4	-0.04	lbf		
21*R5	0.97	lbf		
22*R6	1.49	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#2

\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:39 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.59	lbf		
A18*R2	-22.64	lbf		
A19*R3	23.52	lbf		
A20*R4	0.01	lbf		
A21*R5	1.12	lbf		
A22*R6	1.51	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:41 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A Pressure 1	20.8	psig		
A Pressure 2	21.7	psig		
A15*Press1	20.9	psig		
A16*Press2	21.8	psig		
A17*R1	22.63	lbf		
A18*R2	-23.32	lbf		
A19*R3	24.00	lbf		
A20*R4	-0.08	lbf		
A21*R5	0.88	lbf		
A22*R6	1.46	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#3

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:42 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.57	lbf		
A18*R2	-22.67	lbf		
A19*R3	23.51	lbf		
A20*R4	0.00	lbf		
A21*R5	1.12	lbf		
A22*R6	1.50	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:44 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	29.8	psig		
A8*Pressure 2	30.8	psig		
A15*Press1	29.8	psig		
A16*Press2	30.8	psig		
A17*R1	22.62	lbf		
A18*R2	-23.60	lbf		
A19*R3	24.17	lbf		
A20*R4	-0.11	lbf		
A21*R5	0.80	lbf		
A22*R6	1.44	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

# 4

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:45 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.53	lbf		
A18*R2	-22.66	lbf		
A19*R3	23.49	lbf		
A20*R4	0.00	lbf		
A21*R5	1.12	lbf		
A22*R6	1.49	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:46 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A*Pressure 1	39.3	psig		
A*Pressure 2	40.3	psig		
A15*Press1	39.4	psig		
A16*Press2	40.3	psig		
A17*R1	22.64	lbf		
A18*R2	-23.90	lbf		
A19*R3	24.36	lbf		
A20*R4	-0.16	lbf		
A21*R5	0.70	lbf		
A22*R6	1.42	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:46 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.9	psig		
15*Press1	-2.8	psig		
16*Press2	-1.9	psig		
17*R1	22.51	lbf		
18*R2	-22.65	lbf		
19*R3	23.49	lbf		
20*R4	0.00	lbf		
21*R5	1.12	lbf		
22*R6	1.49	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:47 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
Pressure 1	48.4	psig		
Pressure 2	49.3	psig		
15*Press1	48.4	psig		
16*Press2	49.4	psig		
17*R1	22.67	lbf		
18*R2	-24.15	lbf		
19*R3	24.56	lbf		
20*R4	-0.20	lbf		
21*R5	0.62	lbf		
22*R6	1.40	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#6

\*\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:48 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.50	lbf		
A18*R2	-22.65	lbf		
A19*R3	23.48	lbf		
A20*R4	-0.00	lbf		
A21*R5	1.12	lbf		
A22*R6	1.49	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:49 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	59.9	psig		
A 8*Pressure 2	60.8	psig		
A15*Press1	59.8	psig		
A16*Press2	60.8	psig		
A17*R1	22.64	lbf		
A18*R2	-24.49	lbf		
A19*R3	24.78	lbf		
A20*R4	-0.23	lbf		
A21*R5	0.51	lbf		
A22*R6	1.37	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

# 7

\*\*\*\*\* 8/8/91 P

\*\*\*\*\* Record 00:49 - 00-Jan-72

## System identification data

## Process parameter list

\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.9	psig		
15*Press1	-2.8	psig		
16*Press2	-1.9	psig		
17*R1	22.48	lbf		
18*R2	-22.65	lbf		
19*R3	23.46	lbf		
20*R4	-0.00	lbf		
21*R5	1.12	lbf		
22*R6	1.49	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:51 - 00-Jan-72

## System identification data

## Process parameter list

\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

*Pressure 1	72.8	psig		
Pressure 2	73.8	psig		
15*Press1	72.9	psig		
16*Press2	73.9	psig		
17*R1	22.65	lbf		
18*R2	-24.91	lbf		
19*R3	25.08	lbf		
20*R4	-0.32	lbf		
21*R5	0.39	lbf		
22*R6	1.34	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#8

\*\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:51 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.45	lbf		
A18*R2	-22.65	lbf		
A19*R3	23.46	lbf		
A20*R4	0.00	lbf		
A21*R5	1.12	lbf		
A22*R6	1.48	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:53 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*pressure 1	84.8	psig		
A 8*pressure 2	85.7	psig		
A15*Press1	84.9	psig		
A16*Press2	85.9	psig		
A17*R1	22.66	lbf		
A18*R2	-25.27	lbf		
A19*R3	25.37	lbf		
A20*R4	-0.39	lbf		
A21*R5	0.27	lbf		
A22*R6	1.32	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:53 - 00-Jan-72

## ( System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.44	lbf		
A18*R2	-22.64	lbf		
A19*R3	23.45	lbf		
A20*R4	-0.00	lbf		
A21*R5	1.12	lbf		
A22*R6	1.48	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:54 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A Pressure 1	98.7	psig		
A t Pressure 2	99.6	psig		
A15*Press1	98.7	psig		
A16*Press2	99.6	psig		
A17*R1	22.64	lbf		
A18*R2	-25.69	lbf		
A19*R3	25.77	lbf		
A20*R4	-0.46	lbf		
A21*R5	0.15	lbf		
A22*R6	1.29	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\* 8/8/91

P

\*\*\*\*\* Record 00:54 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.43	lbf		
A18*R2	-22.62	lbf		
A19*R3	23.45	lbf		
A20*R4	-0.00	lbf		
A21*R5	1.11	lbf		
A22*R6	1.48	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:55 - 00-Jan-72

## System identification data

## Process parameter list

## \*\*\* Chan.data \*\*\*

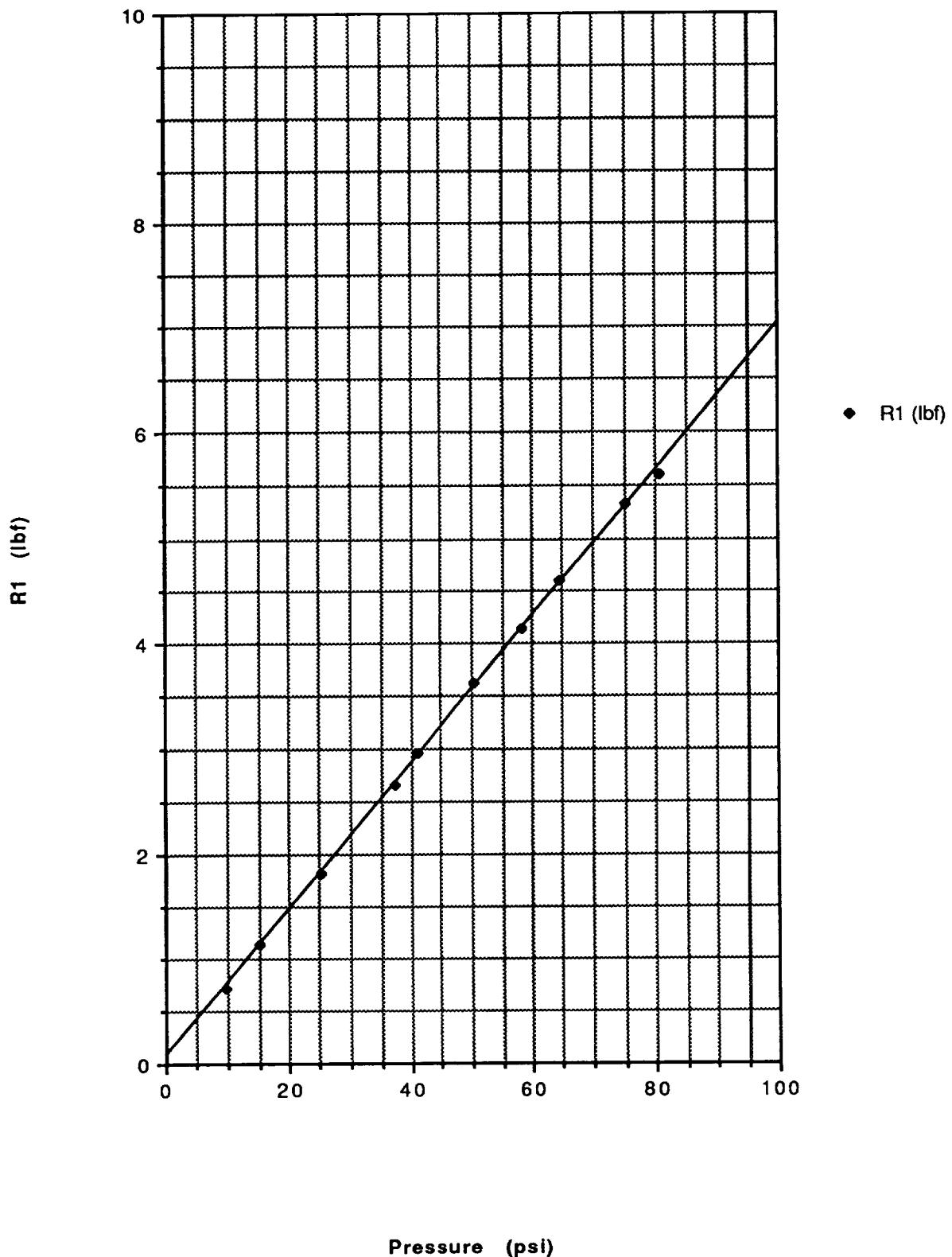
# Name	Value	Unit	Alarm	messages
A Pressure 1	113.3	psig		
A E Pressure 2	114.2	psig		
A15*Press1	113.4	psig		
A16*Press2	114.2	psig		
A17*R1	22.58	lbf		
A18*R2	-26.13	lbf		
A19*R3	26.18	lbf		
A20*R4	-0.54	lbf		
A21*R5	0.02	lbf		
A22*R6	1.26	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

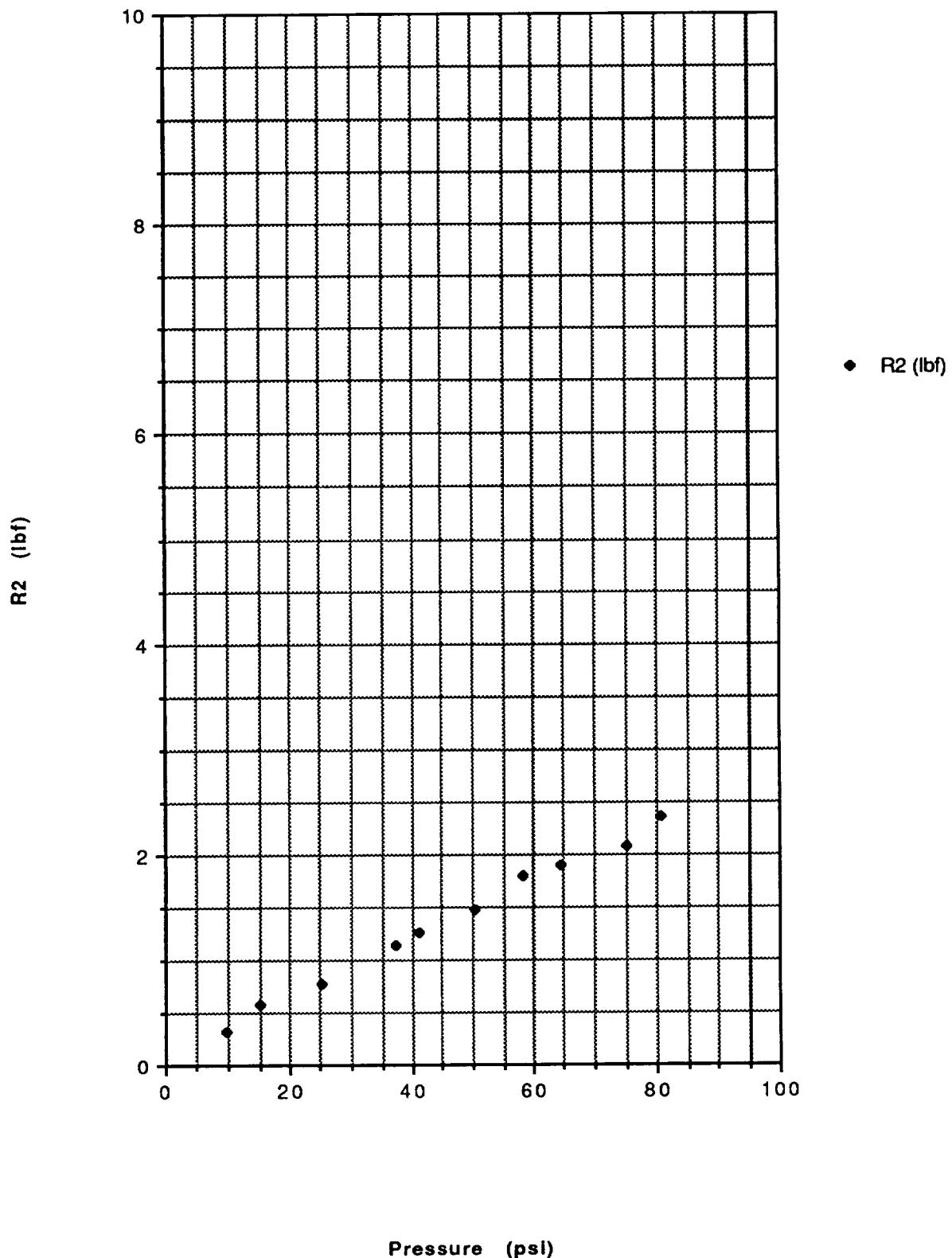
**APPENDIX E**

**8/8/91 STRAIGHT NOZZLE RUN**

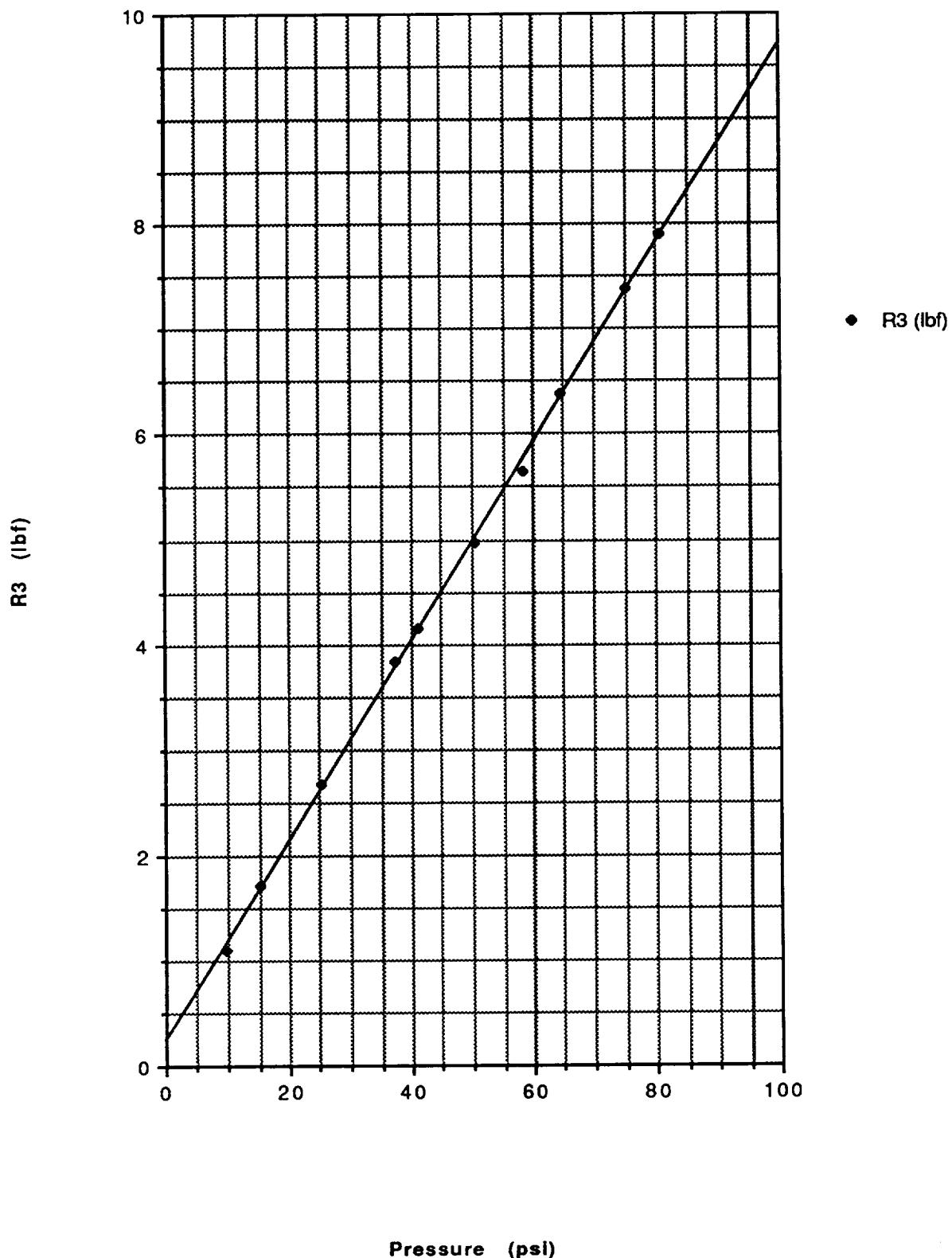
**Data from "8/8/91 Straight"**



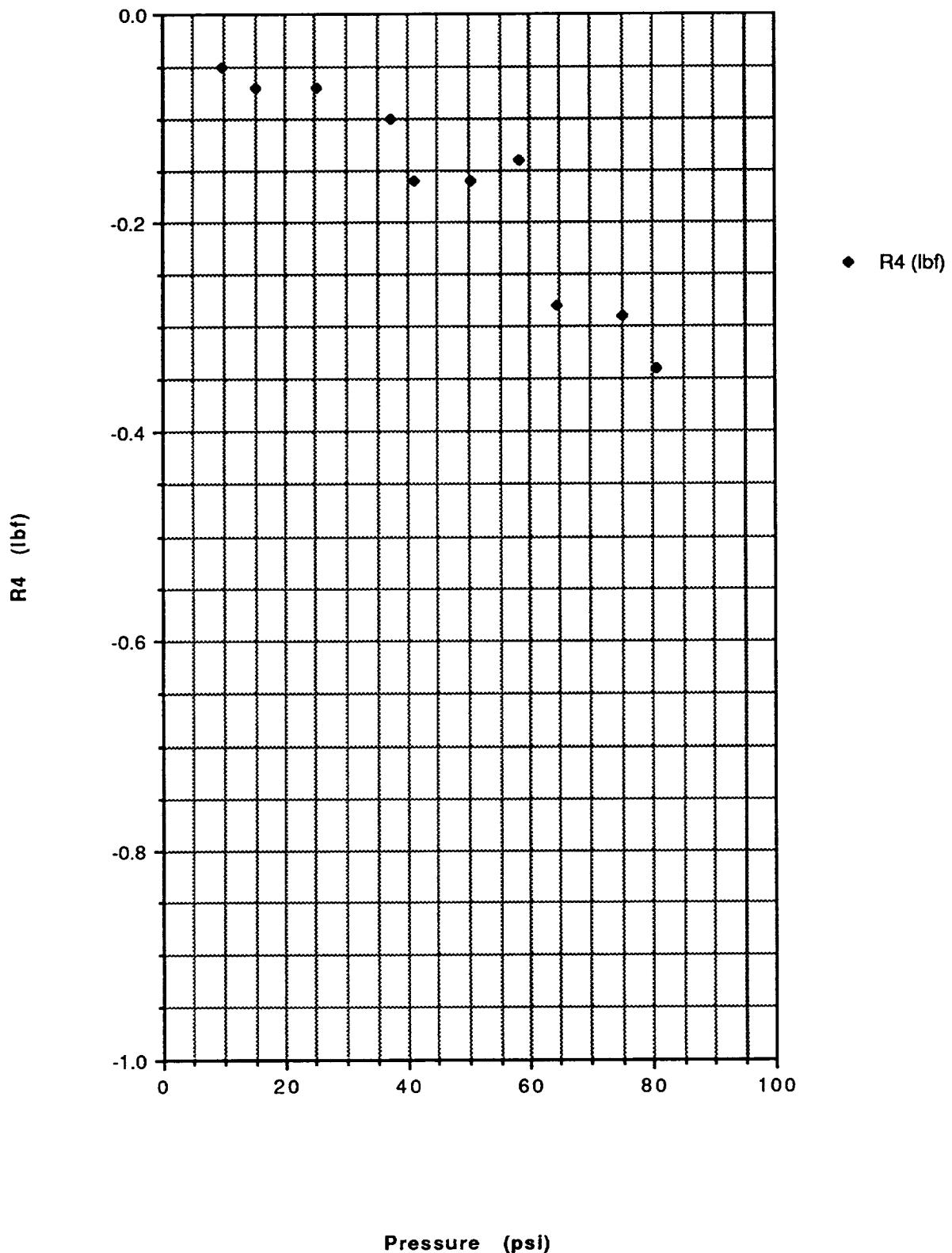
**Data from "8/8/91 Straight"**



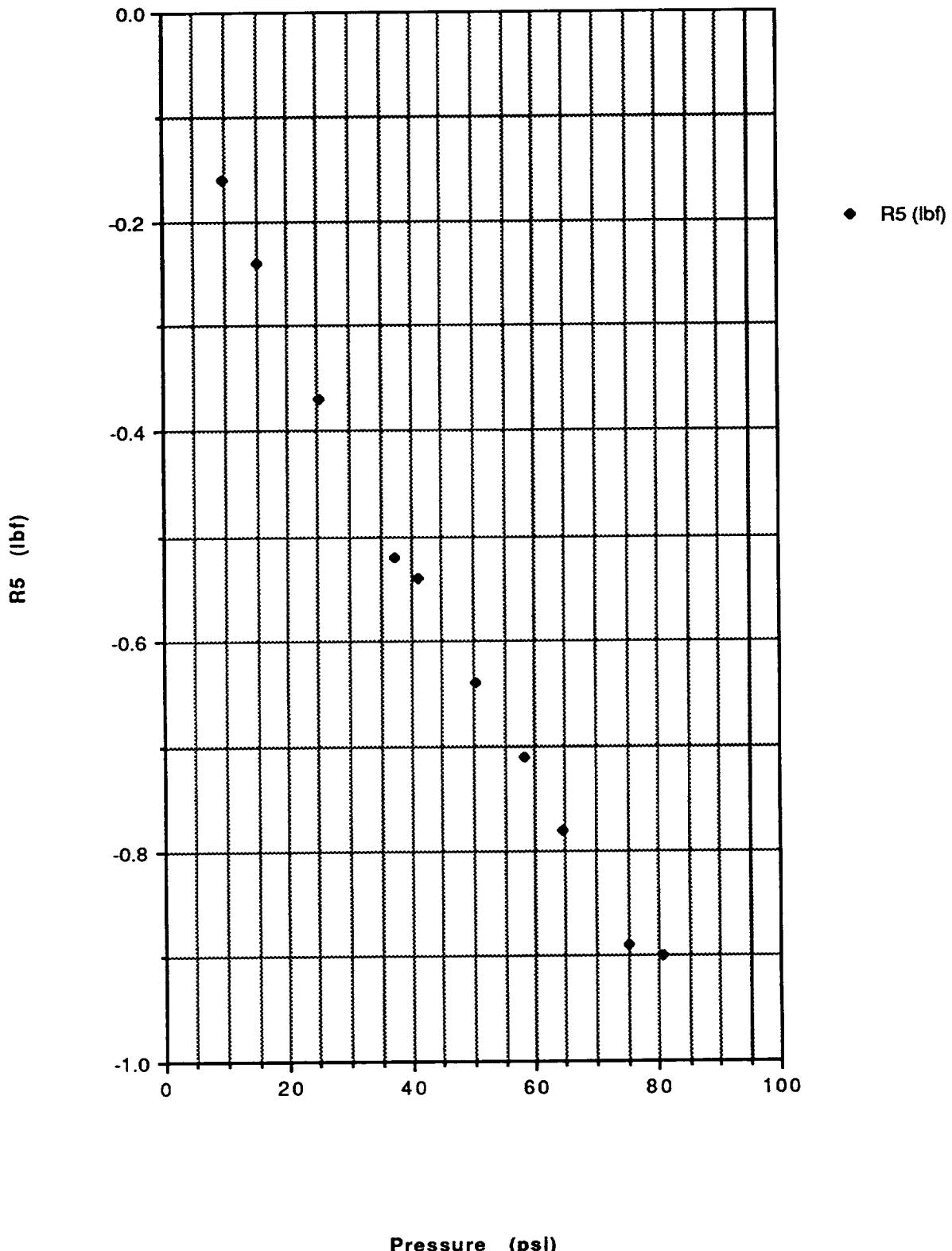
**Data from "8/8/91 Straight"**



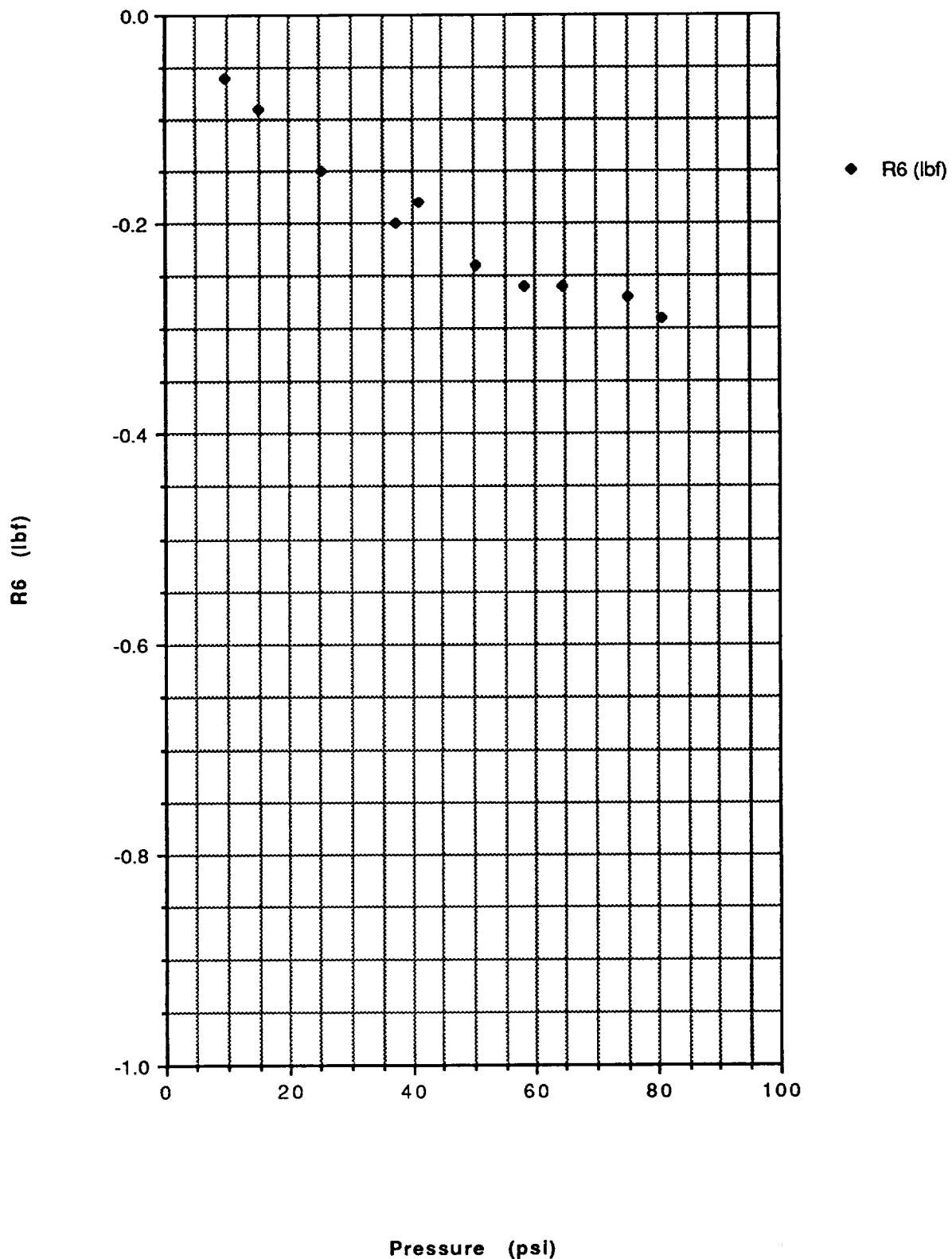
**Data from "8/8/91 Straight"**



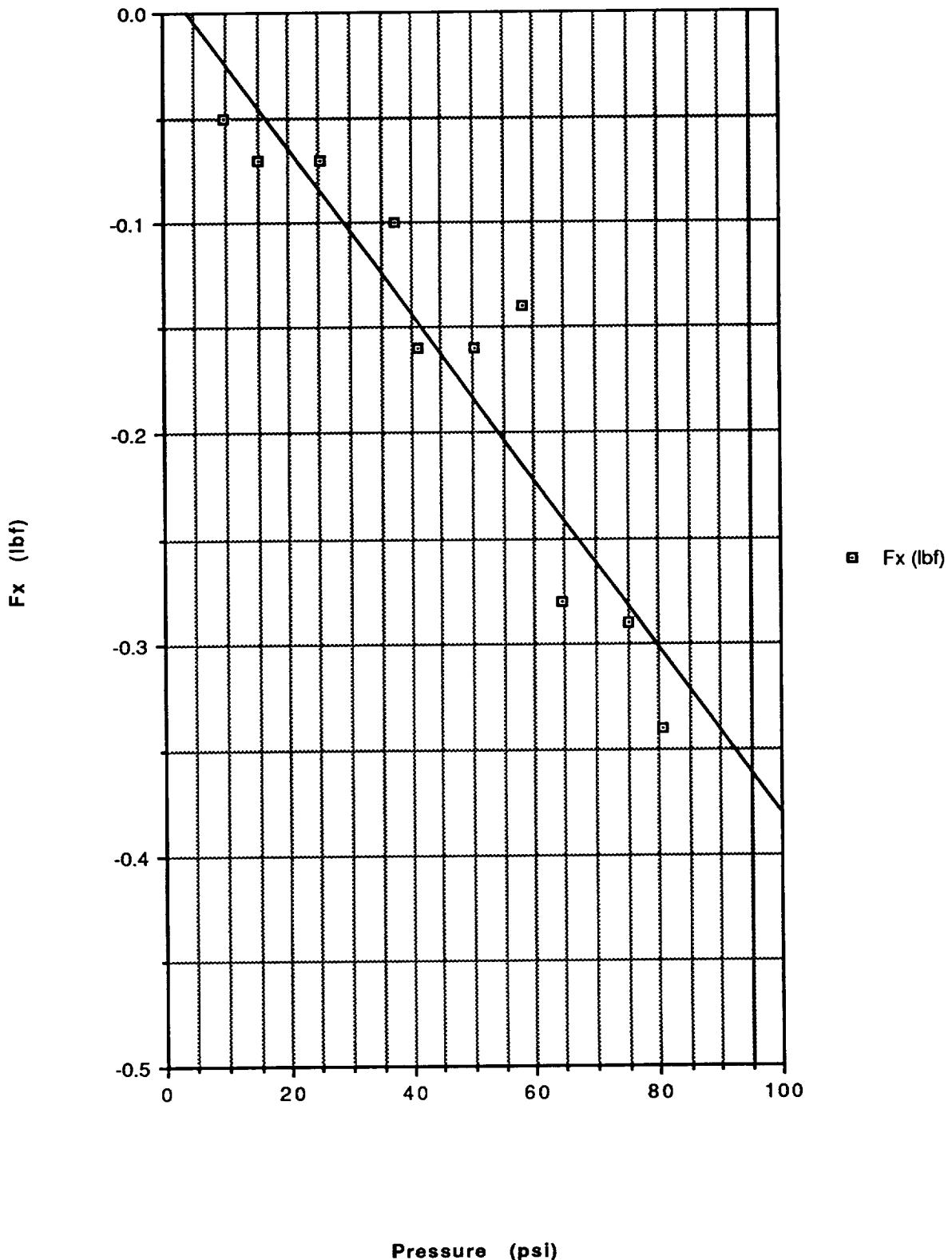
**Data from "8/8/91 Straight"**



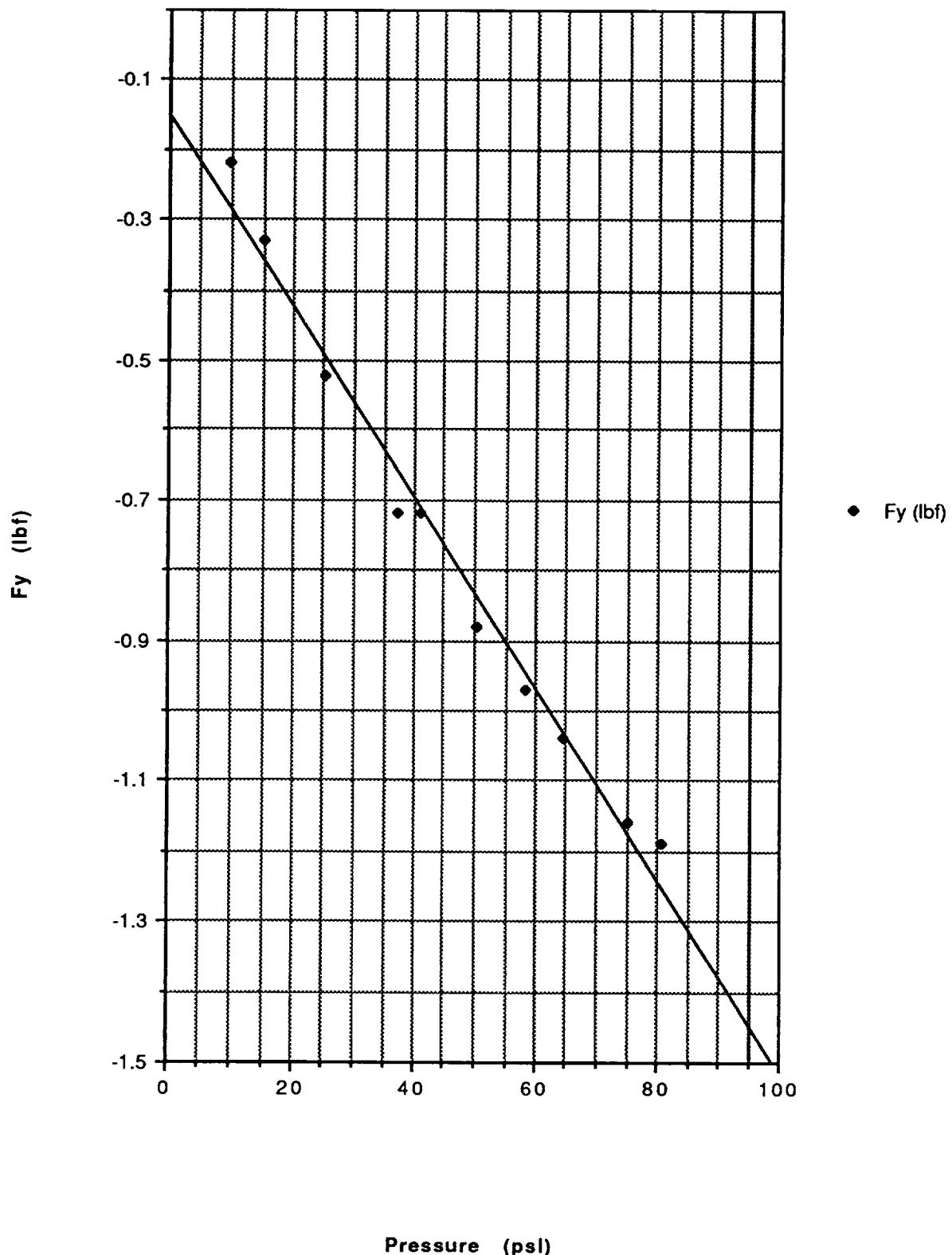
**Data from "8/8/91 Straight"**



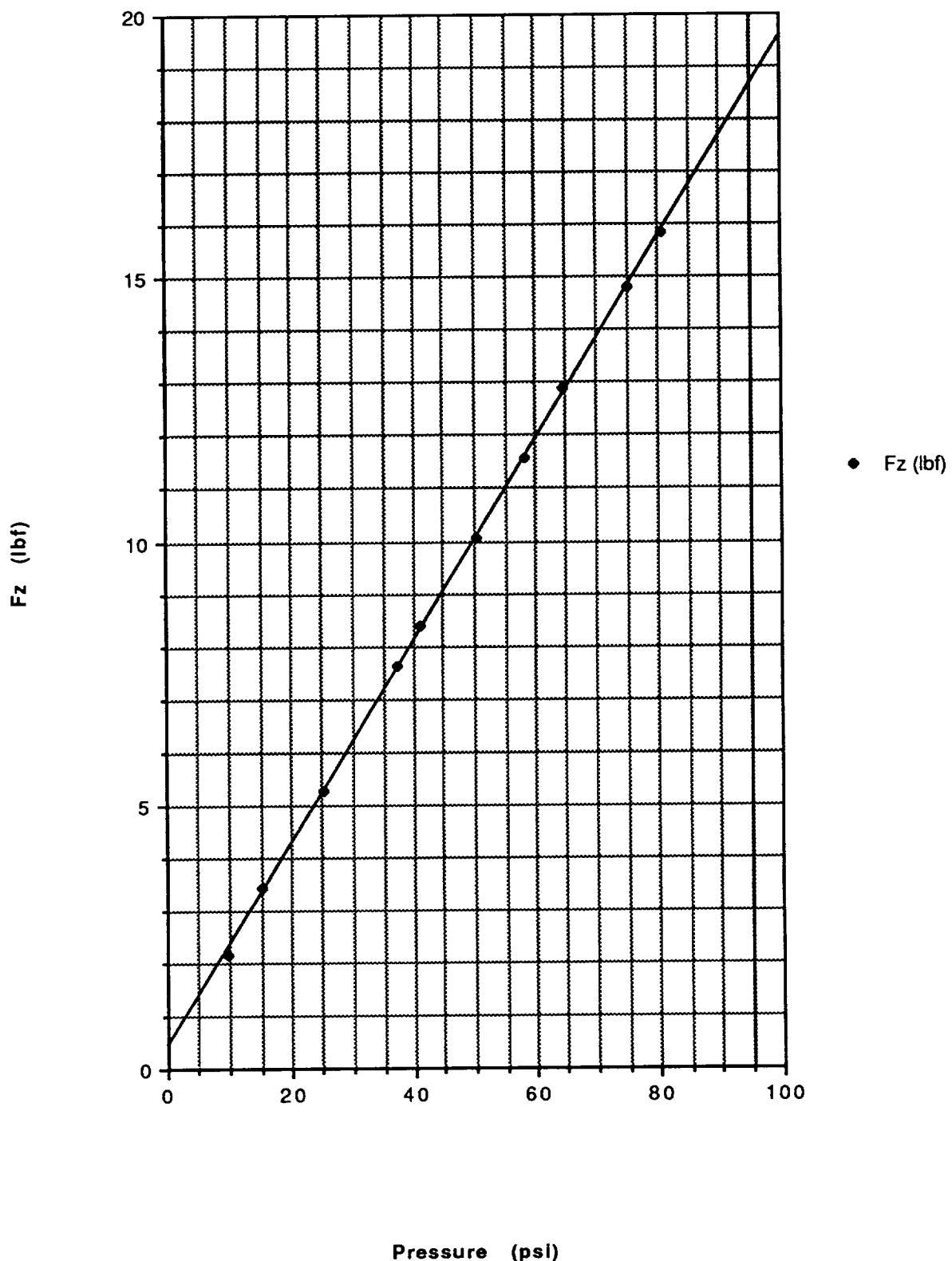
**Data from "8/8/91 Straight"**



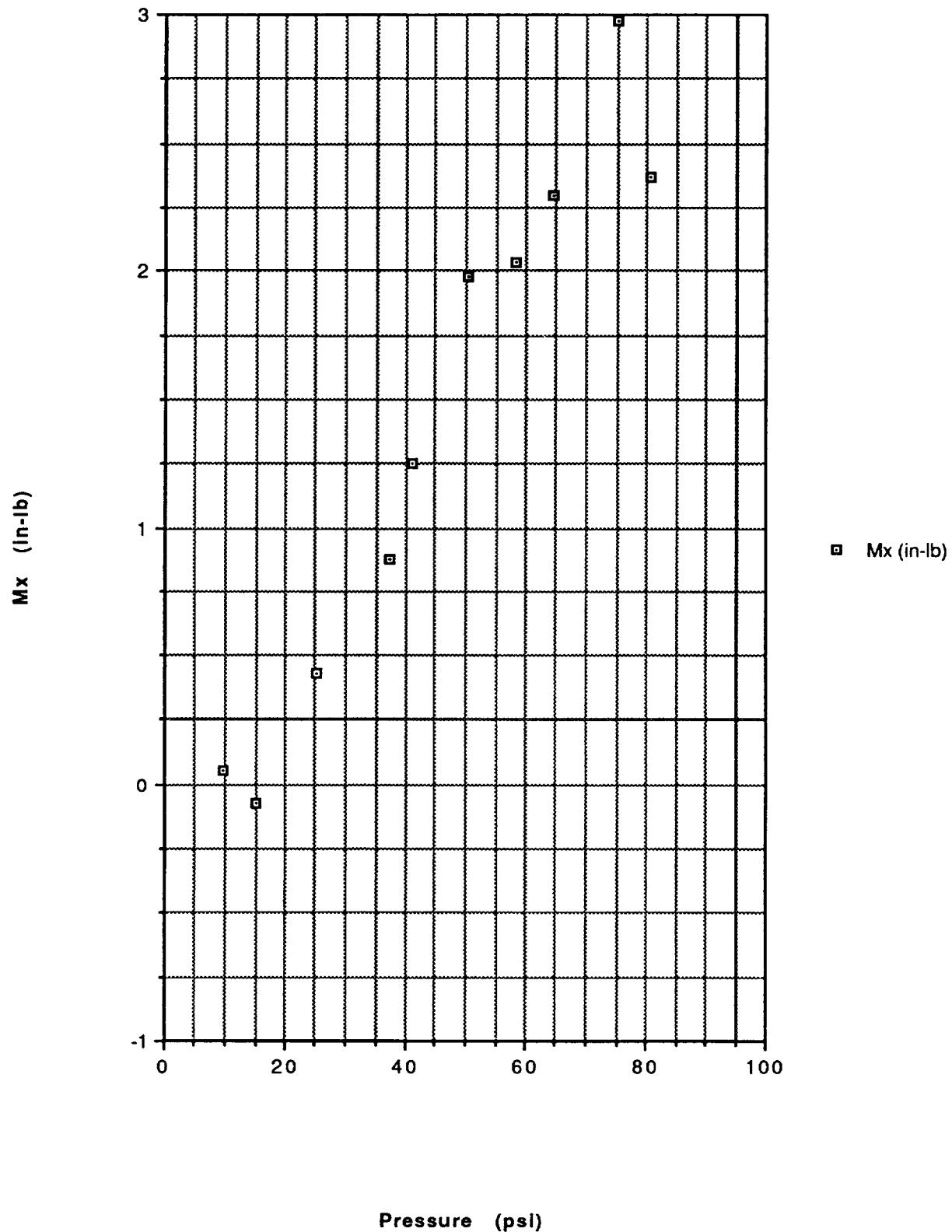
**Data from "8/8/91 Straight"**



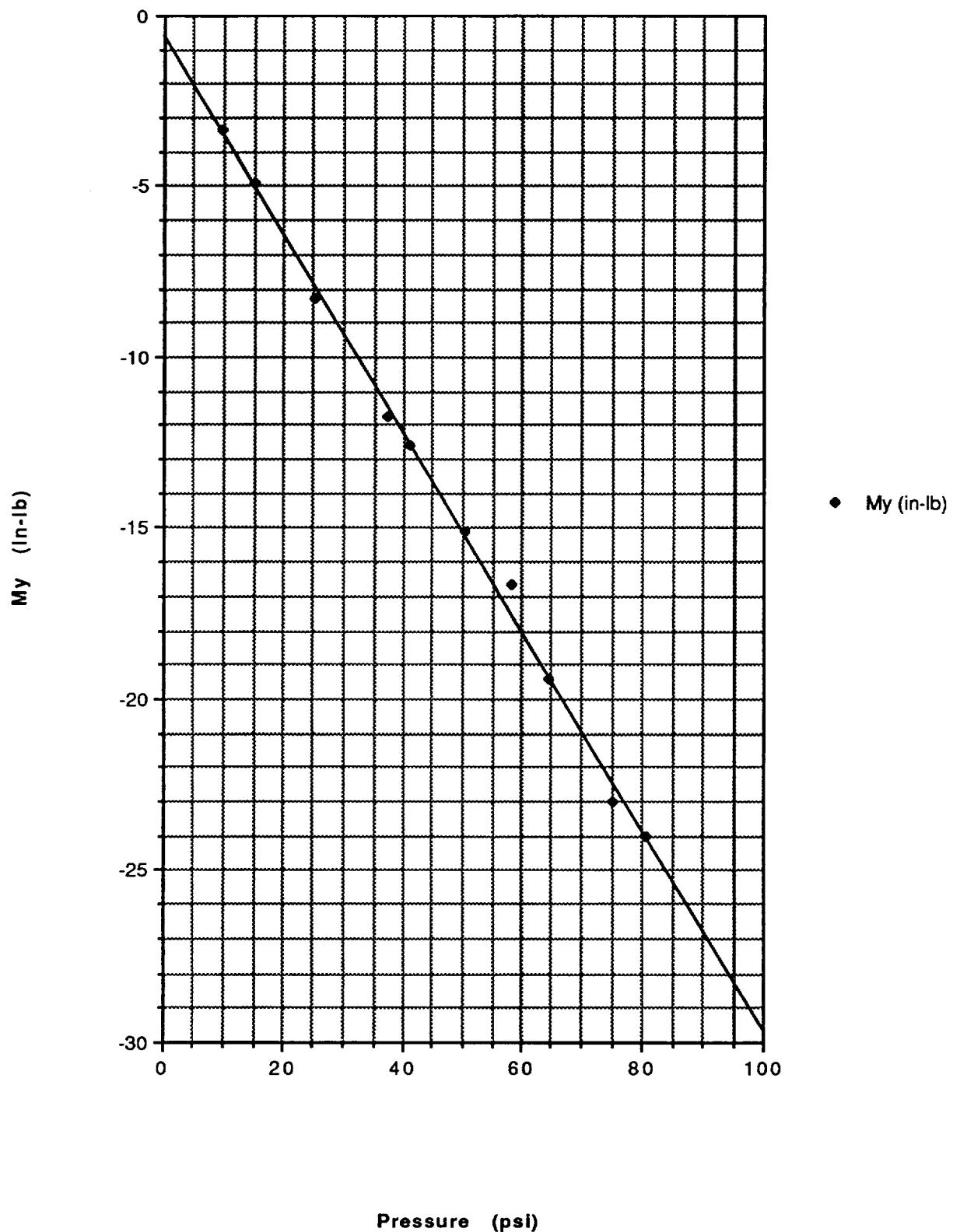
**Data from "8/8/91 Straight"**



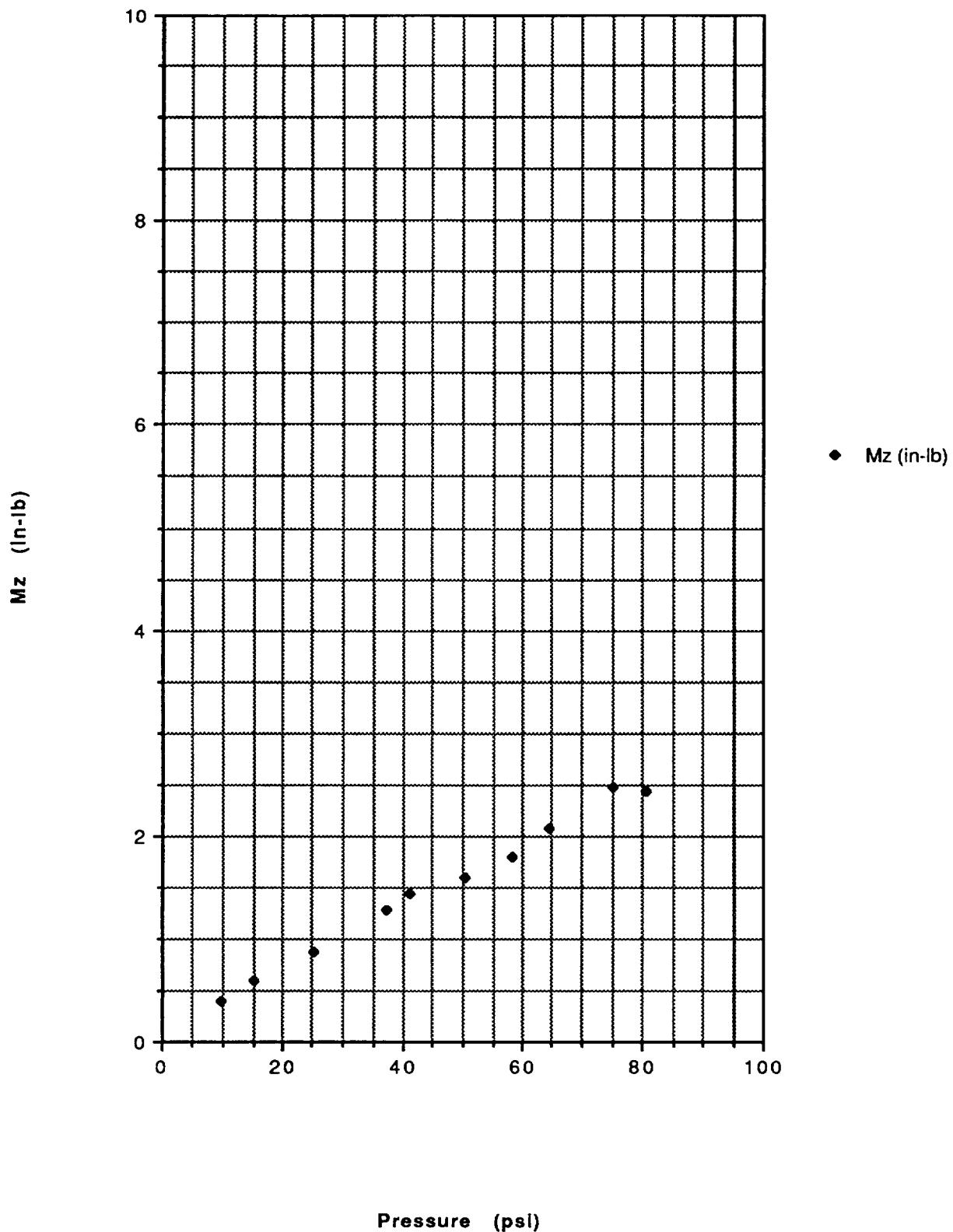
**Data from "8/8/91 Straight"**



**Data from "8/8/91 Straight"**



**Data from "8/8/91 Straight"**



8/8/91 Straight CG DATA

Thu, Aug 15, 1991 2:31 PM

Pressure (psi)	Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (in-lb)	My (in-lb)	Mz (in-lb)
9.800	-0.050	-0.220	2.140	0.050	-3.380	0.400
15.200	-0.070	-0.330	3.420	-0.070	-4.890	0.600
25.200	-0.070	-0.520	5.260	0.430	-8.270	0.880
37.300	-0.100	-0.720	7.630	0.880	-11.730	1.280
40.900	-0.160	-0.720	8.380	1.250	-12.560	1.440
50.400	-0.160	-0.880	10.070	1.980	-15.110	1.600
58.300	-0.140	-0.970	11.580	2.030	-16.670	1.800
64.600	-0.280	-1.040	12.880	2.300	-19.400	2.080
75.300	-0.290	-1.160	14.800	2.980	-22.990	2.480
80.800	-0.340	-1.190	15.850	2.370	-24.030	2.440

8/8/91 Straight CG DATA

Thu, Aug 15, 1991 2:31 PM

	R1 (lbf)	R2 (lbf)	R3 (lbf)	R4 (lbf)	R5 (lbf)	R6 (lbf)
	0.720	0.320	1.100	-0.050	-0.160	-0.060
3	1.130	0.580	1.710	-0.070	-0.240	-0.090
4	1.810	0.770	2.680	-0.070	-0.370	-0.150
5	2.660	1.130	3.840	-0.100	-0.520	-0.200
6	2.960	1.260	4.160	-0.160	-0.540	-0.180
7	3.620	1.480	4.970	-0.160	-0.640	-0.240
8	4.130	1.800	5.650	-0.140	-0.710	-0.260
9	4.600	1.900	6.380	-0.280	-0.780	-0.260
10	5.330	2.080	7.390	-0.290	-0.890	-0.270
	5.600	2.350	7.900	-0.340	-0.900	-0.290

A342

# 1

\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:04 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.8	psig		
15*Press1	-2.8	psig		
16*Press2	-1.8	psig		
17*R1	22.48	lbf		
18*R2	-22.24	lbf		
19*R3	23.78	lbf		
20*R4	-0.18	lbf		
21*R5	1.21	lbf		
22*R6	1.71	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:06 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	11.8	psig		
8*Pressure 2	8.0	psig		
15*Press1	11.8	psig		
16*Press2	8.1	psig		
17*R1	23.20	lbf		
18*R2	-21.92	lbf		
19*R3	24.88	lbf		
20*R4	-0.23	lbf		
21*R5	1.05	lbf		
22*R6	1.65	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#2

\*\*\*\*\* 8/8/91 5

\*\*\*\*\* Record 00:06 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.8	psig		
A17*R1	22.41	lbf		
A18*R2	-22.33	lbf		
A19*R3	23.69	lbf		
A20*R4	-0.19	lbf		
A21*R5	1.21	lbf		
A22*R6	1.70	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:07 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A Pressure 1	18.2	psig		
A Pressure 2	13.3	psig		
A15*Press1	18.3	psig		
A16*Press2	13.2	psig		
A17*R1	23.54	lbf		
A18*R2	-21.75	lbf		
A19*R3	25.40	lbf		
A20*R4	-0.26	lbf		
A21*R5	0.97	lbf		
A22*R6	1.61	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

73

\*\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:08 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.41	lbf		
A18*R2	-22.29	lbf		
A19*R3	23.69	lbf		
A20*R4	-0.18	lbf		
A21*R5	1.21	lbf		
A22*R6	1.70	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:10 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	30.7	psig		
A8*Pressure 2	23.3	psig		
A15*Press1	30.6	psig		
A16*Press2	23.3	psig		
A17*R1	24.22	lbf		
A18*R2	-21.52	lbf		
A19*R3	26.37	lbf		
A20*R4	-0.25	lbf		
A21*R5	0.84	lbf		
A22*R6	1.55	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

#4

\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:11 - 00-Jan-72

identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.9	psig		
15*Press1	-2.8	psig		
16*Press2	-1.9	psig		
17*R1	22.40	lbf		
18*R2	-22.31	lbf		
19*R3	23.69	lbf		
20*R4	-0.16	lbf		
21*R5	1.20	lbf		
22*R6	1.69	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:14 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	45.2	psig		
8*Pressure 2	35.4	psig		
15*Press1	45.0	psig		
16*Press2	35.2	psig		
17*R1	25.06	lbf		
18*R2	-21.18	lbf		
19*R3	27.53	lbf		
20*R4	-0.26	lbf		
21*R5	0.68	lbf		
22*R6	1.49	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:14 - 00-Jan-72

identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.41	lbf		
A18*R2	-22.30	lbf		
A19*R3	23.69	lbf		
A20*R4	-0.12	lbf		
A21*R5	1.19	lbf		
A22*R6	1.67	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:15 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	49.4	psig		
A 8*Pressure 2	39.0	psig		
A15*Press1	49.6	psig		
A16*Press2	39.0	psig		
A17*R1	25.37	lbf		
A18*R2	-21.04	lbf		
A19*R3	27.85	lbf		
A20*R4	-0.28	lbf		
A21*R5	0.65	lbf		
A22*R6	1.49	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

116

\*\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:16 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.41	lbf		
A18*R2	-22.31	lbf		
A19*R3	23.69	lbf		
A20*R4	-0.11	lbf		
A21*R5	1.19	lbf		
A22*R6	1.66	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:19 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	61.5	psig		
A8*Pressure 2	48.5	psig		
A15*Press1	61.3	psig		
A16*Press2	48.6	psig		
A17*R1	26.03	lbf		
A18*R2	-20.83	lbf		
A19*R3	28.66	lbf		
A20*R4	-0.27	lbf		
A21*R5	0.55	lbf		
A22*R6	1.42	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/8/91

S

\*\*\*\*\* Record 00:20 - 00-Jan-72

## System identification data

## Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.43	lbf		
A18*R2	-22.40	lbf		
A19*R3	23.67	lbf		
A20*R4	-0.07	lbf		
A21*R5	1.18	lbf		
A22*R6	1.64	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:23 - 00-Jan-72

## System identification data

## Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	70.6	psig		
A8*Pressure 2	56.4	psig		
A15*Press1	70.5	psig		
A16*Press2	56.3	psig		
A17*R1	26.56	lbf		
A18*R2	-20.60	lbf		
A19*R3	29.32	lbf		
A20*R4	-0.21	lbf		
A21*R5	0.47	lbf		
A22*R6	1.38	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/8/91

S

\*\*\*\*\* Record 00:23 - 00-Jan-72

ES

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.8	psig		
A8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.43	lbf		
A18*R2	-22.40	lbf		
A19*R3	23.65	lbf		
A20*R4	-0.04	lbf		
A21*R5	1.17	lbf		
A22*R6	1.62	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:25 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	78.2	psig		
A8*Pressure 2	62.7	psig		
A15*Press1	78.4	psig		
A16*Press2	63.0	psig		
A17*R1	27.03	lbf		
A18*R2	-20.50	lbf		
A19*R3	30.03	lbf		
A20*R4	-0.32	lbf		
A21*R5	0.39	lbf		
A22*R6	1.36	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/8/91 S

\*\*\*\*\* Record 00:25 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.9	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.9	psig		
A17*R1	22.44	lbf		
A18*R2	-22.43	lbf		
A19*R3	23.62	lbf		
A20*R4	-0.02	lbf		
A21*R5	1.17	lbf		
A22*R6	1.60	lbf		

\*\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:27 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A Pressure 1	90.9	psig		
A Pressure 2	73.4	psig		
A15*Press1	90.6	psig		
A16*Press2	73.0	psig		
A17*R1	27.73	lbf		
A18*R2	-20.35	lbf		
A19*R3	31.01	lbf		
A20*R4	-0.31	lbf		
A21*R5	0.28	lbf		
A22*R6	1.33	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

# 10

\*\*\*\* 8/8/91

S

\*\*\*\*\* Record 00:28 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.9	psig		
15*Press1	-2.8	psig		
16*Press2	-1.9	psig		
17*R1	22.50	lbf		
18*R2	-22.50	lbf		
19*R3	23.61	lbf		
20*R4	0.03	lbf		
21*R5	1.15	lbf		
22*R6	1.58	lbf		

\*\*\*\* 8/8/91

\*\*\*\*\* Record 00:29 - 00-Jan-72

## System identification data

## Process parameter list

## \*\* Chan.data \*\*\*

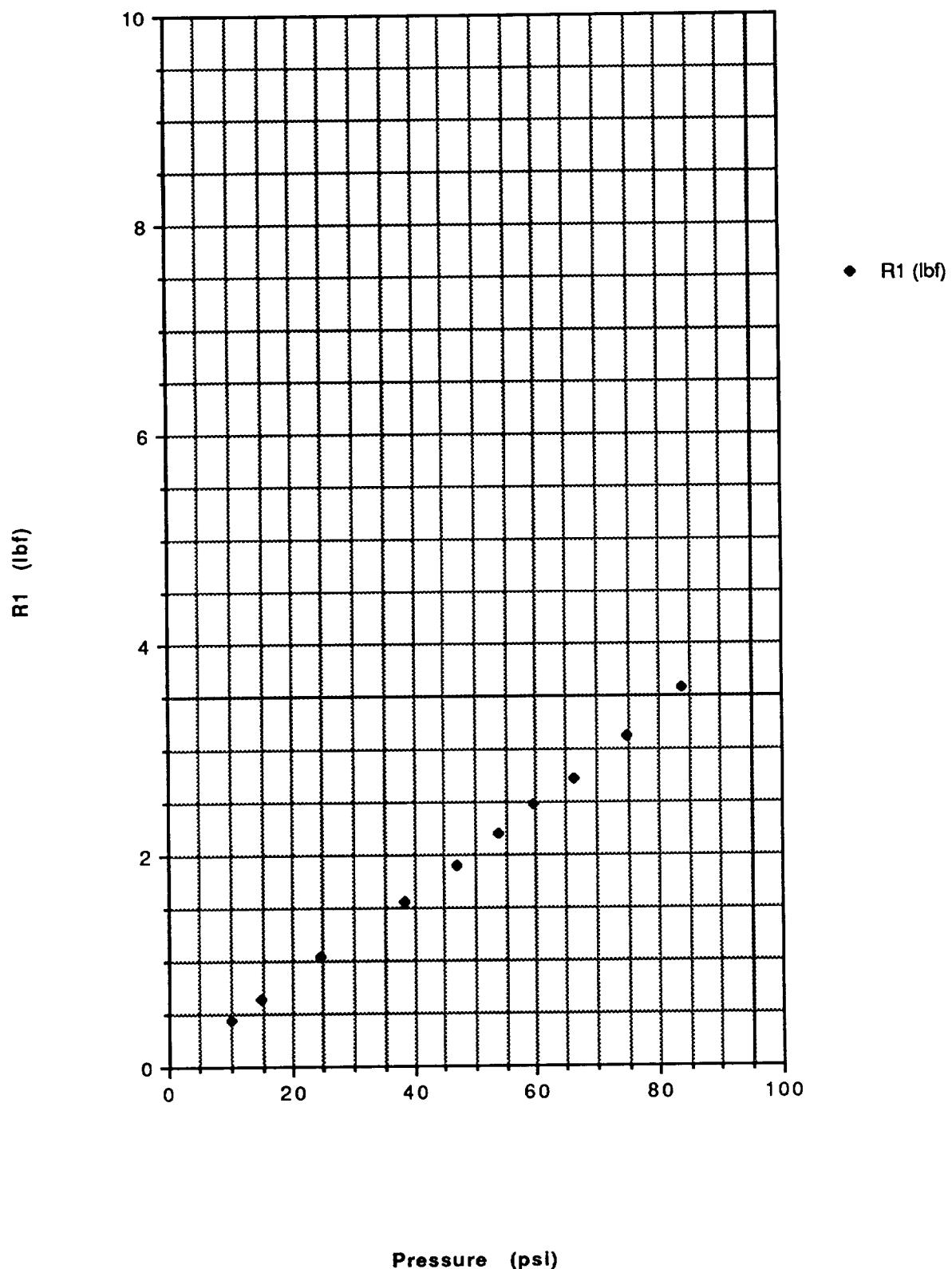
# Name	Value	Unit	Alarm	messages
Pressure 1	97.5	psig		
6 Pressure 2	78.9	psig		
15*Press1	97.5	psig		
16*Press2	78.9	psig		
17*R1	28.10	lbf		
18*R2	-20.15	lbf		
19*R3	31.51	lbf		
20*R4	-0.31	lbf		
21*R5	0.25	lbf		
22*R6	1.29	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

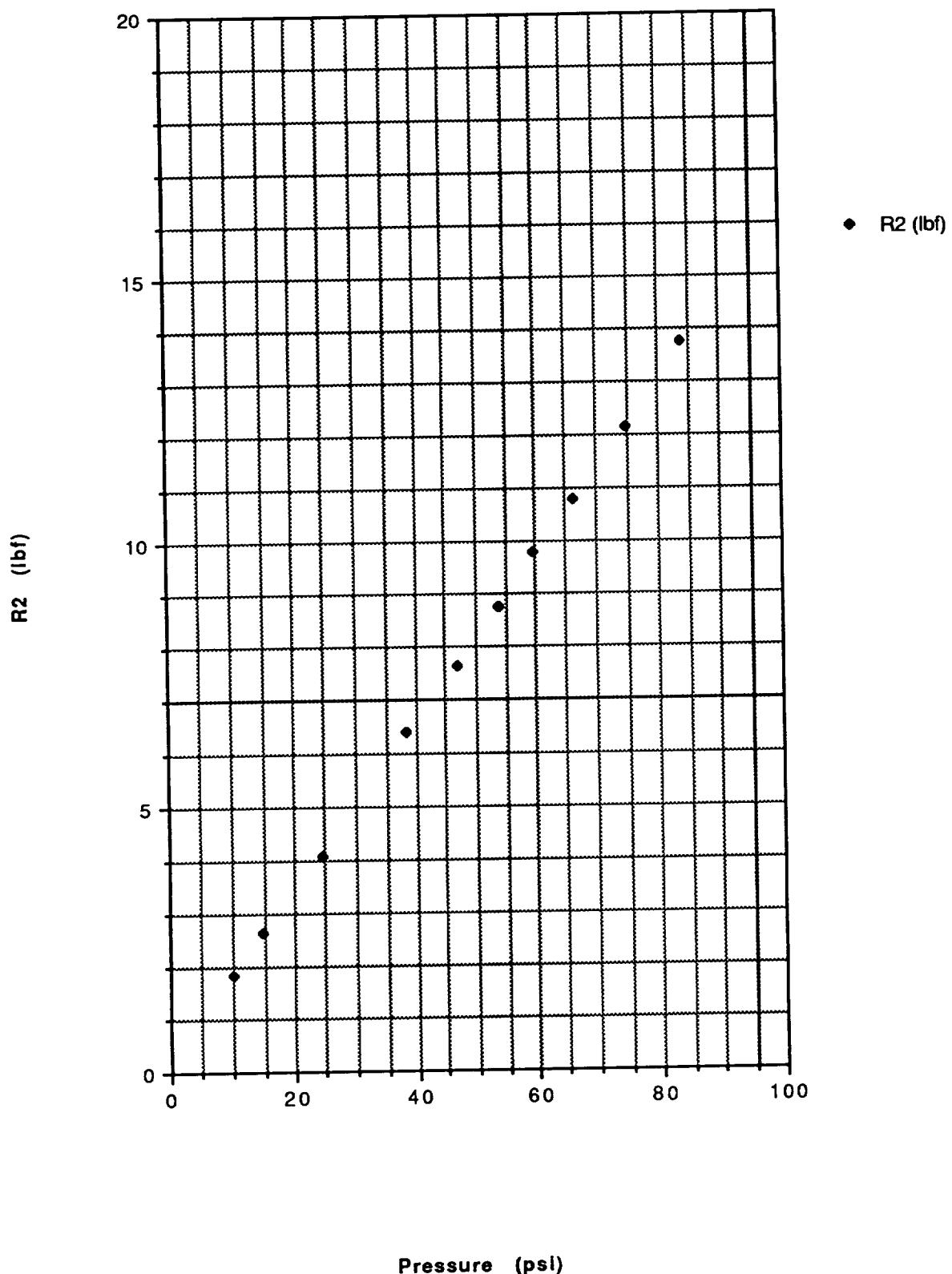
## APPENDIX F

**8/8/91 STRAIGHT NOZZLE RUN  
(PLENUM REVERSED)**

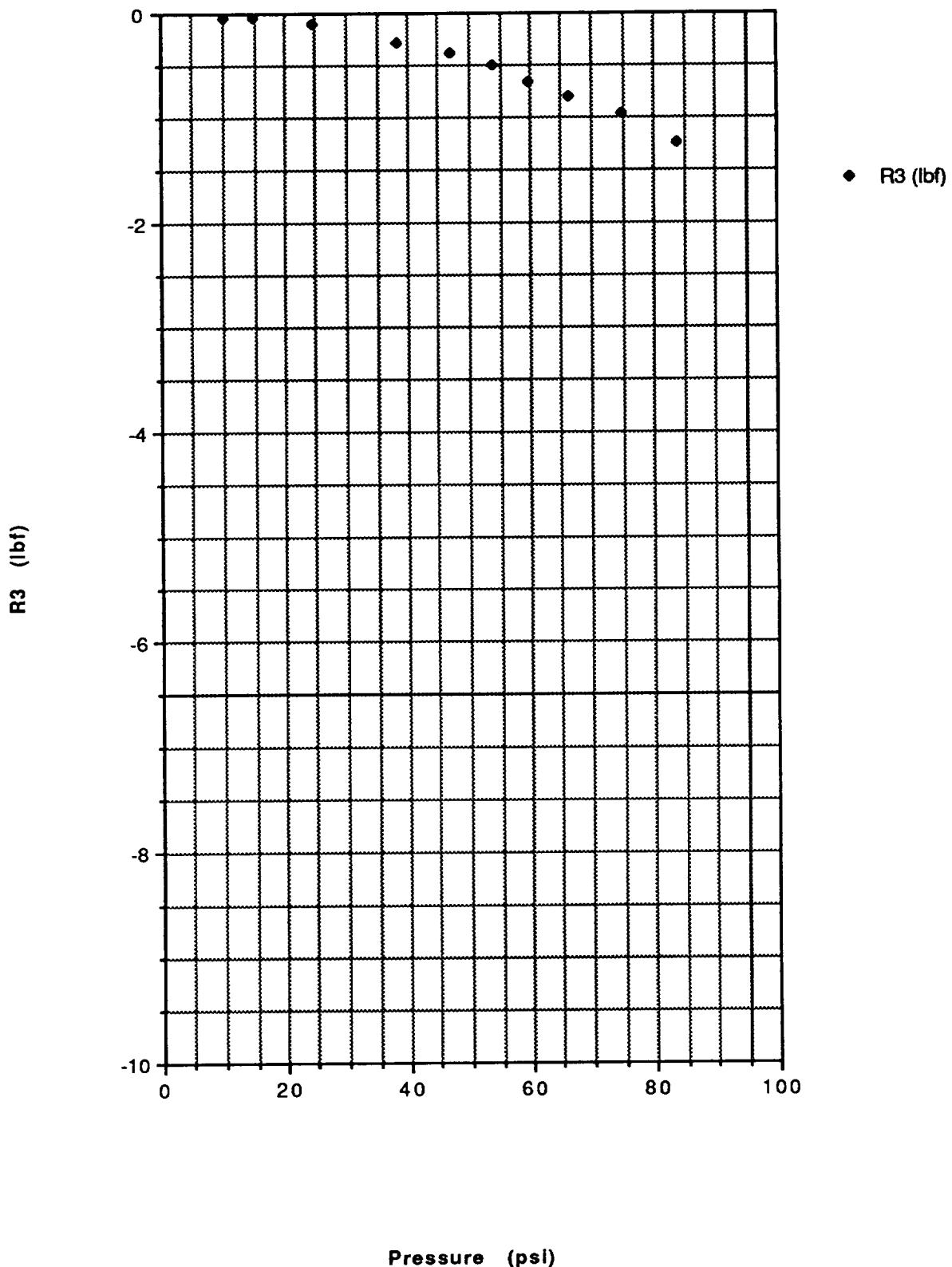
**Data from "8/8/91 Str.P.Rev. CG DATA"**



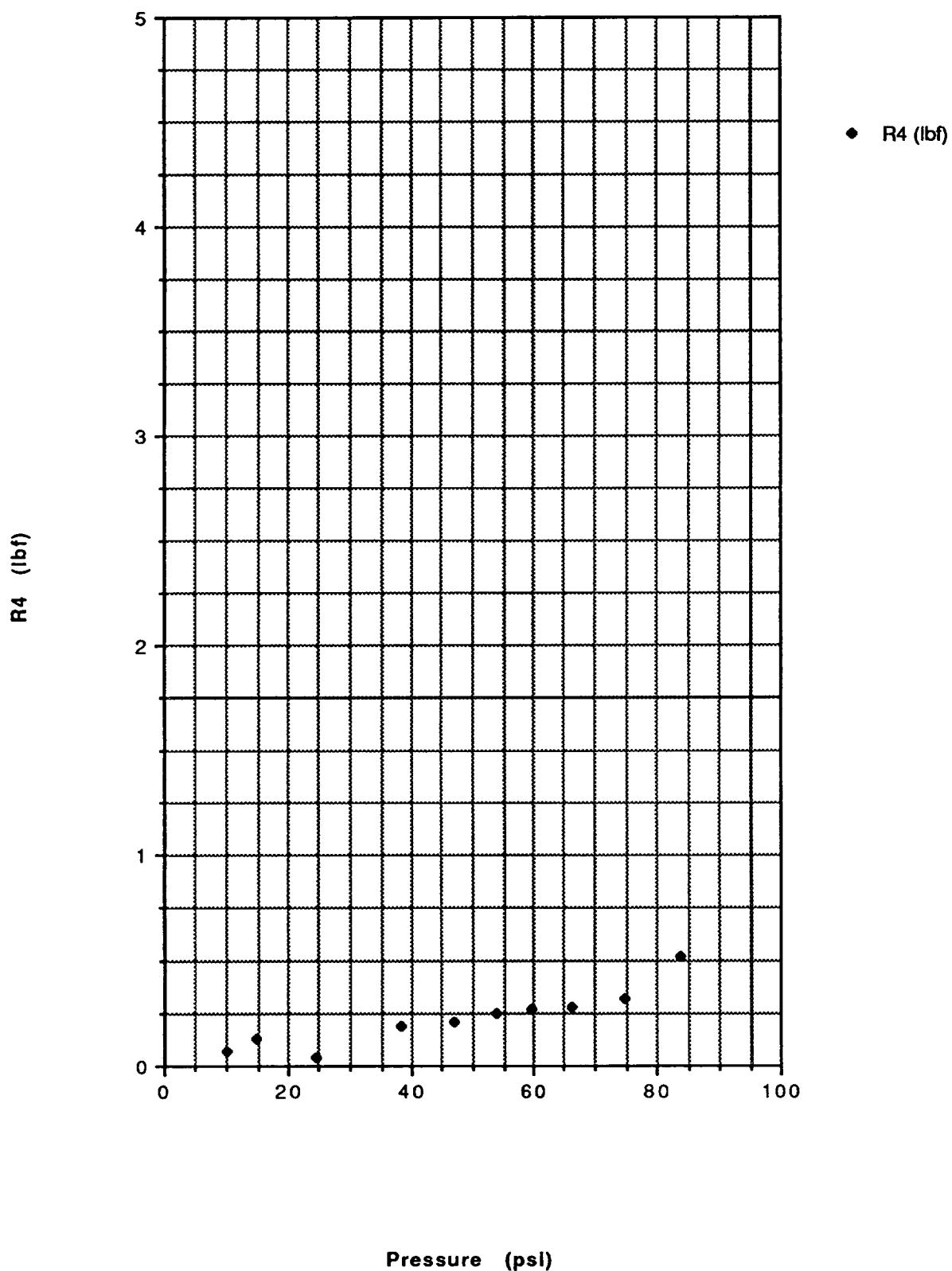
**Data from "8/8/91 Str.P.Rev. CG DATA"**



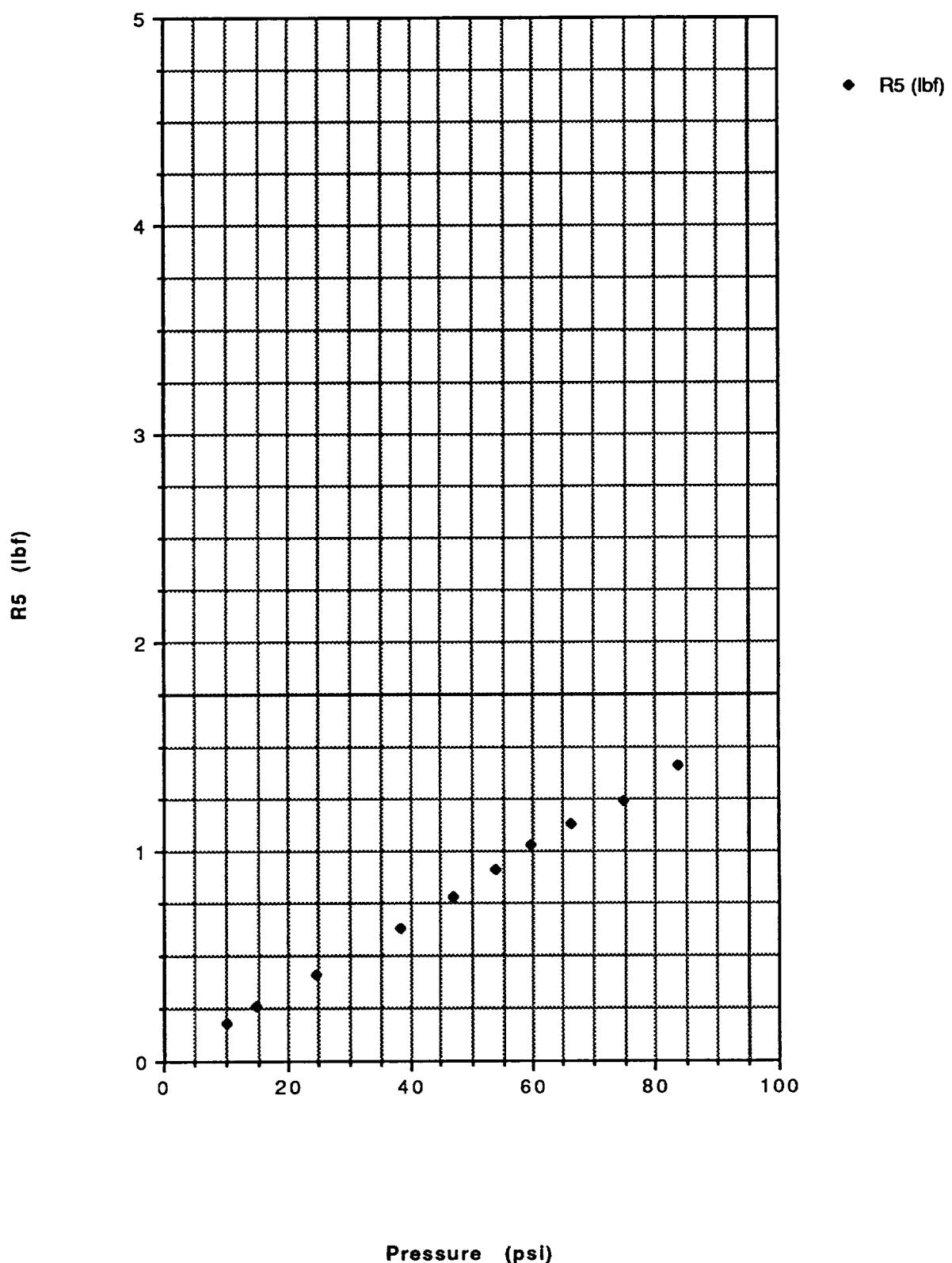
**Data from "8/8/91 Str.P.Rev. CG DATA"**



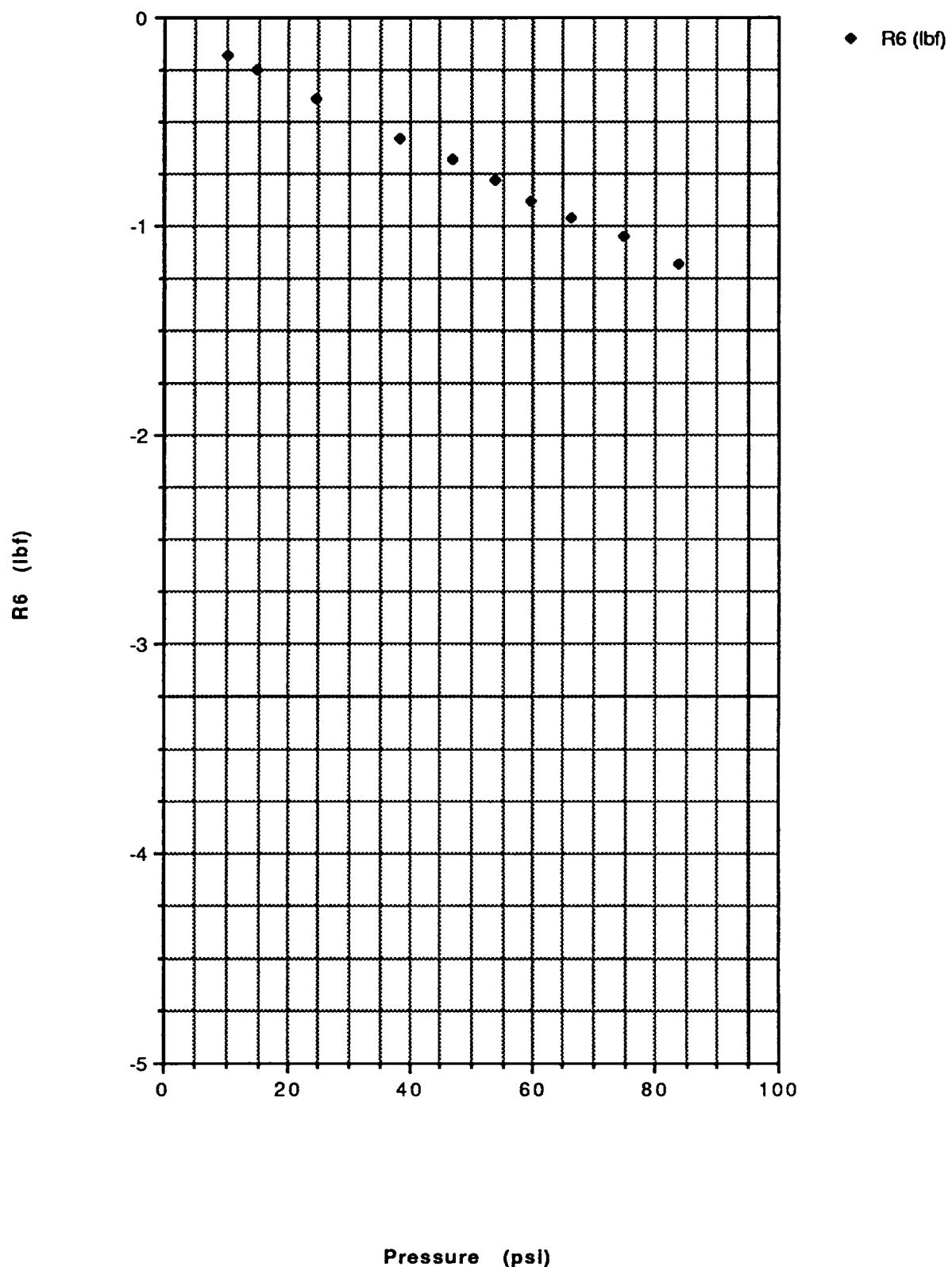
**Data from "8/8/91 Str.P.Rev. CG DATA"**



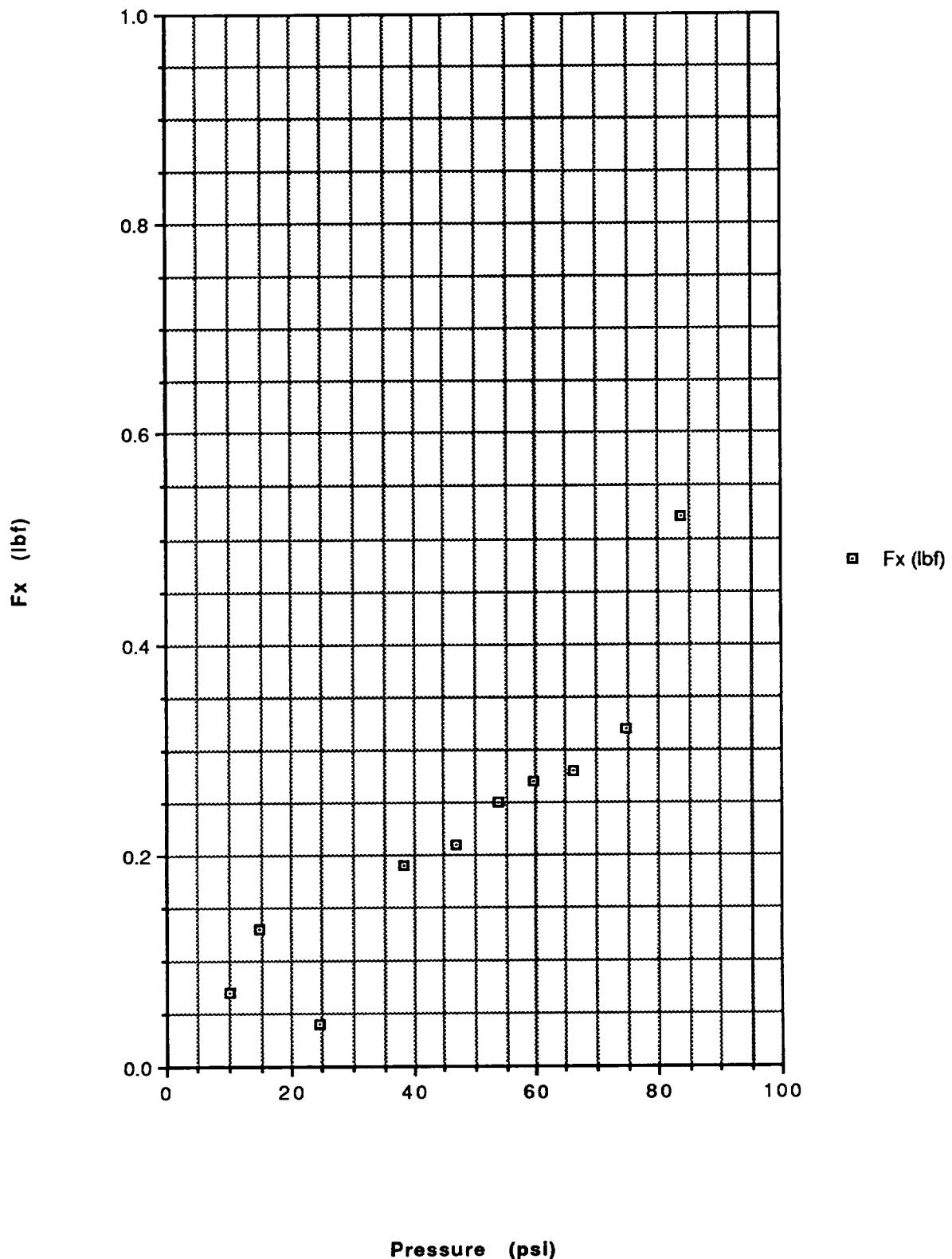
**Data from "8/8/91 Str.P.Rev. CG DATA"**



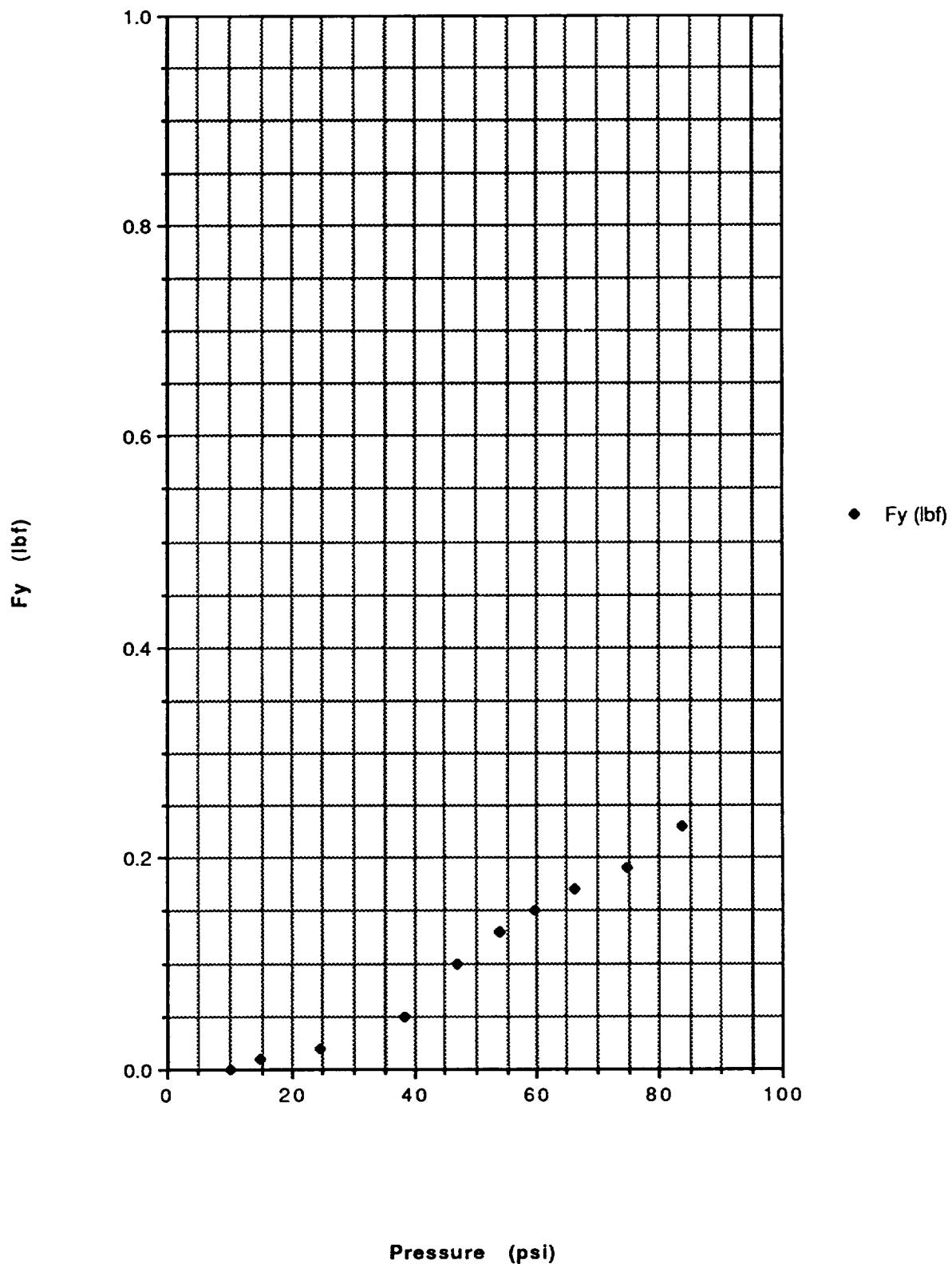
**Data from "8/8/91 Str.P.Rev. CG DATA"**



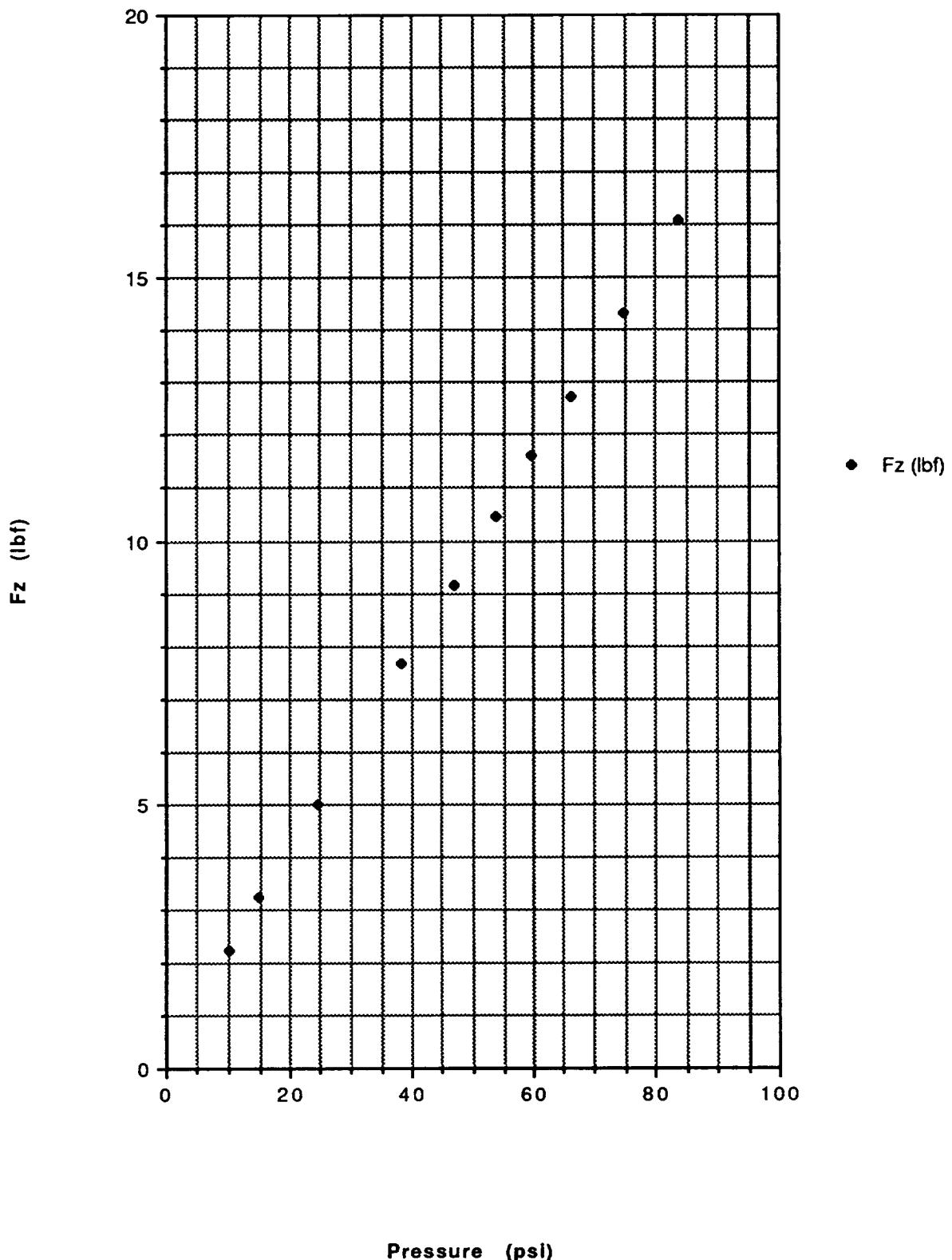
**Data from "8/8/91 Str.P.Rev. CG DATA"**



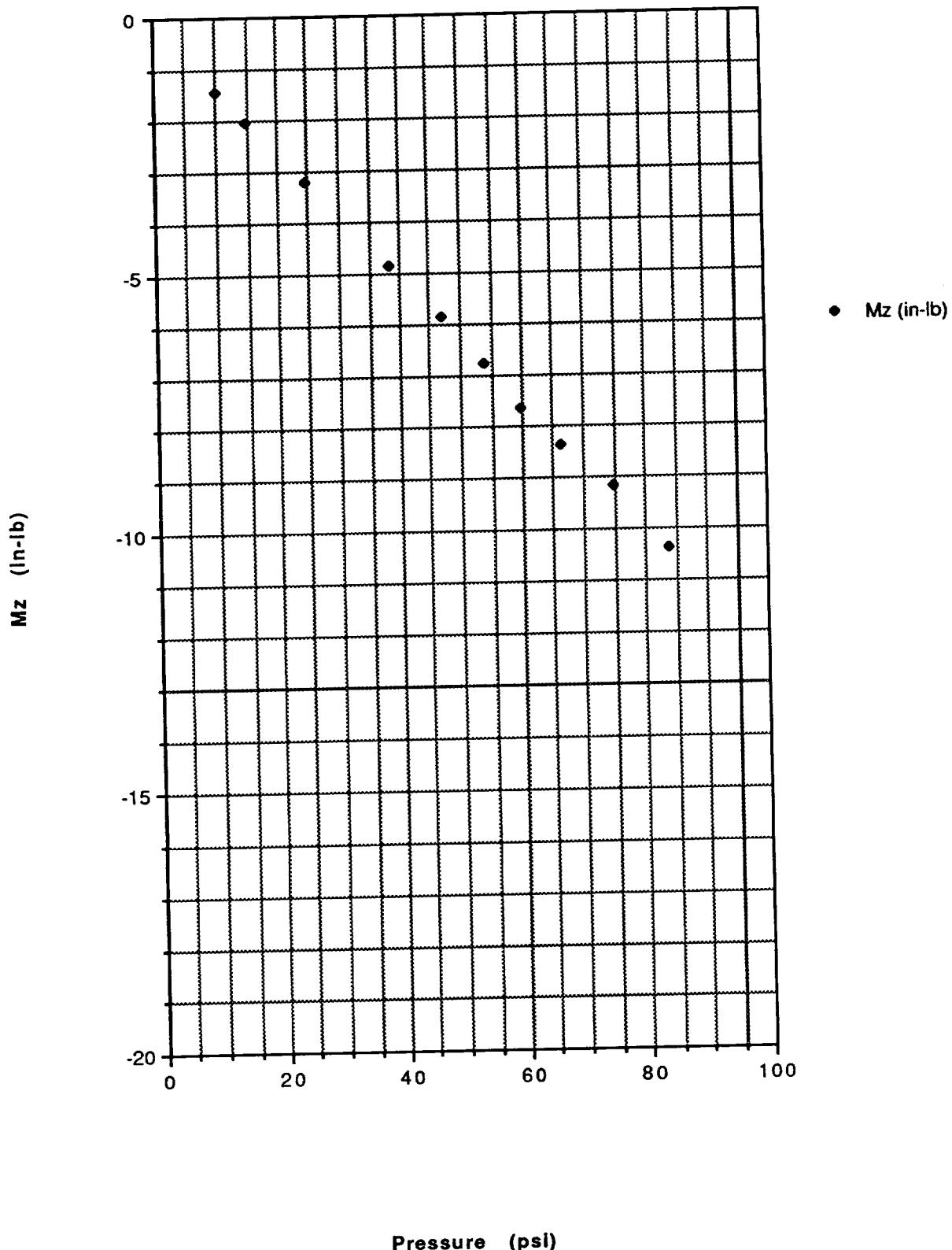
**Data from "8/8/91 Str.P.Rev. CG DATA"**



**Data from "8/8/91 Str.P.Rev. CG DATA"**



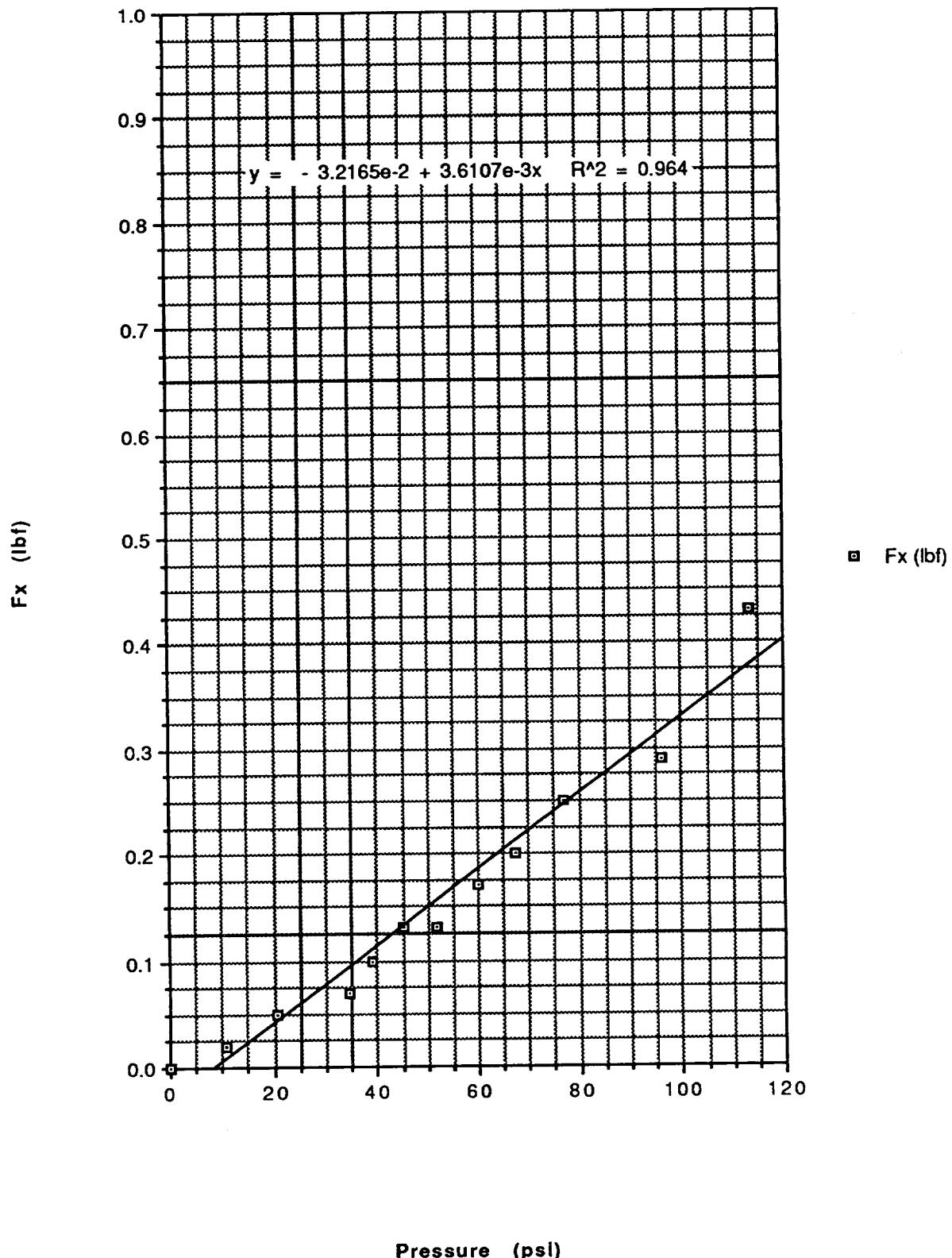
**Data from "8/8/91 Str.P.Rev. CG DATA"**



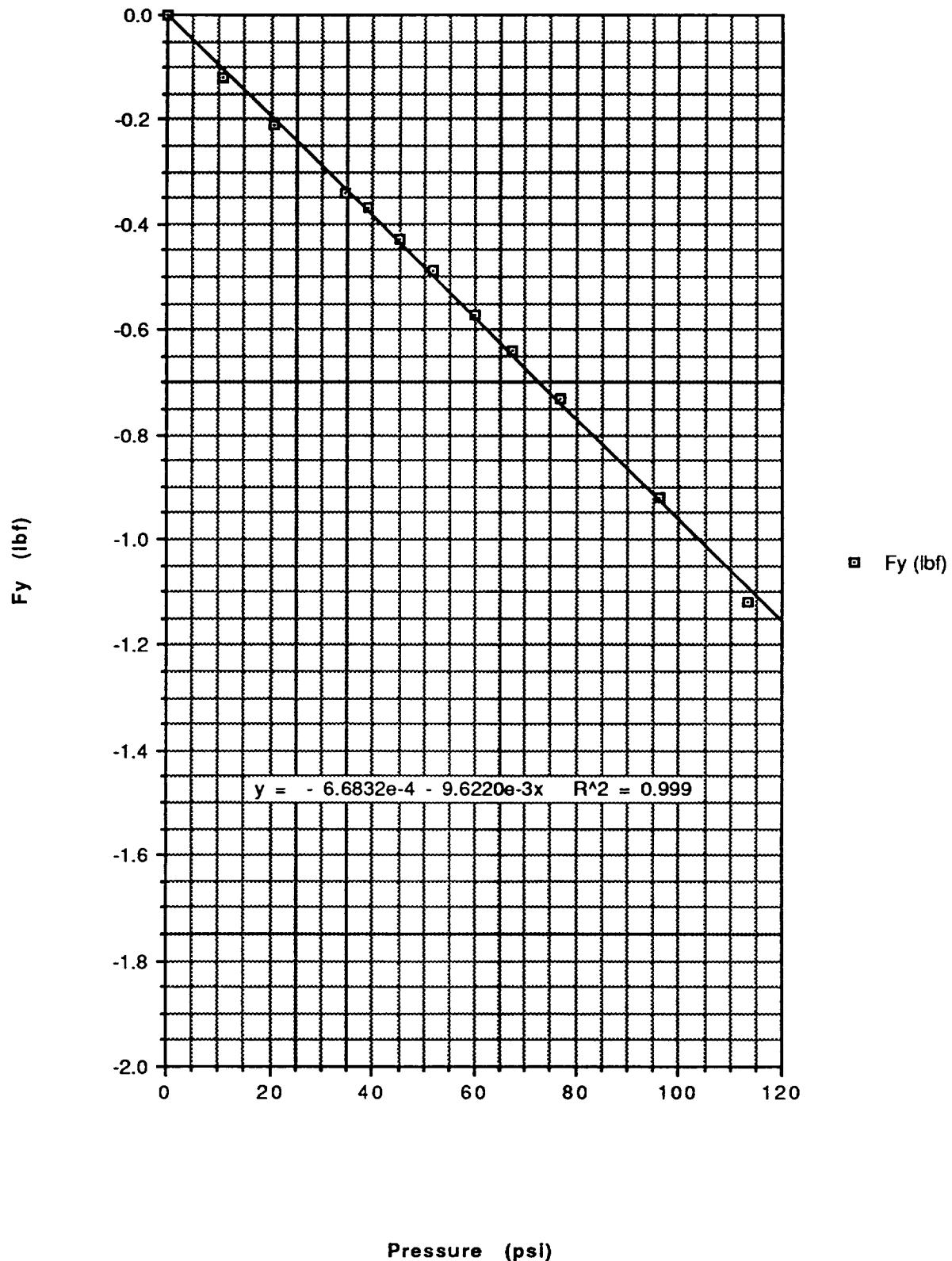
**APPENDIX G**

**8/15/91 PLUG NOZZLE DATA**

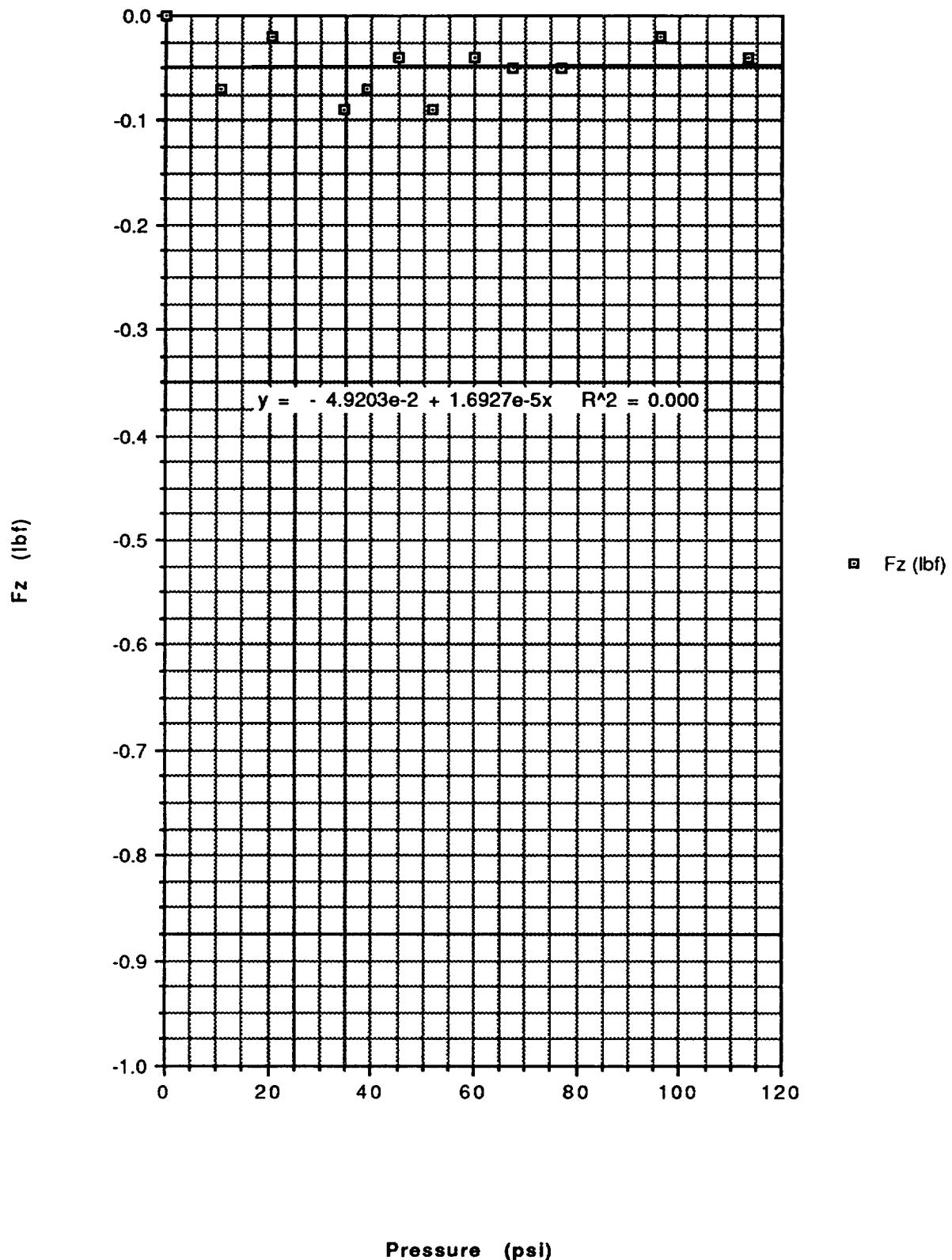
Data from "8/15/91 Plug Data"



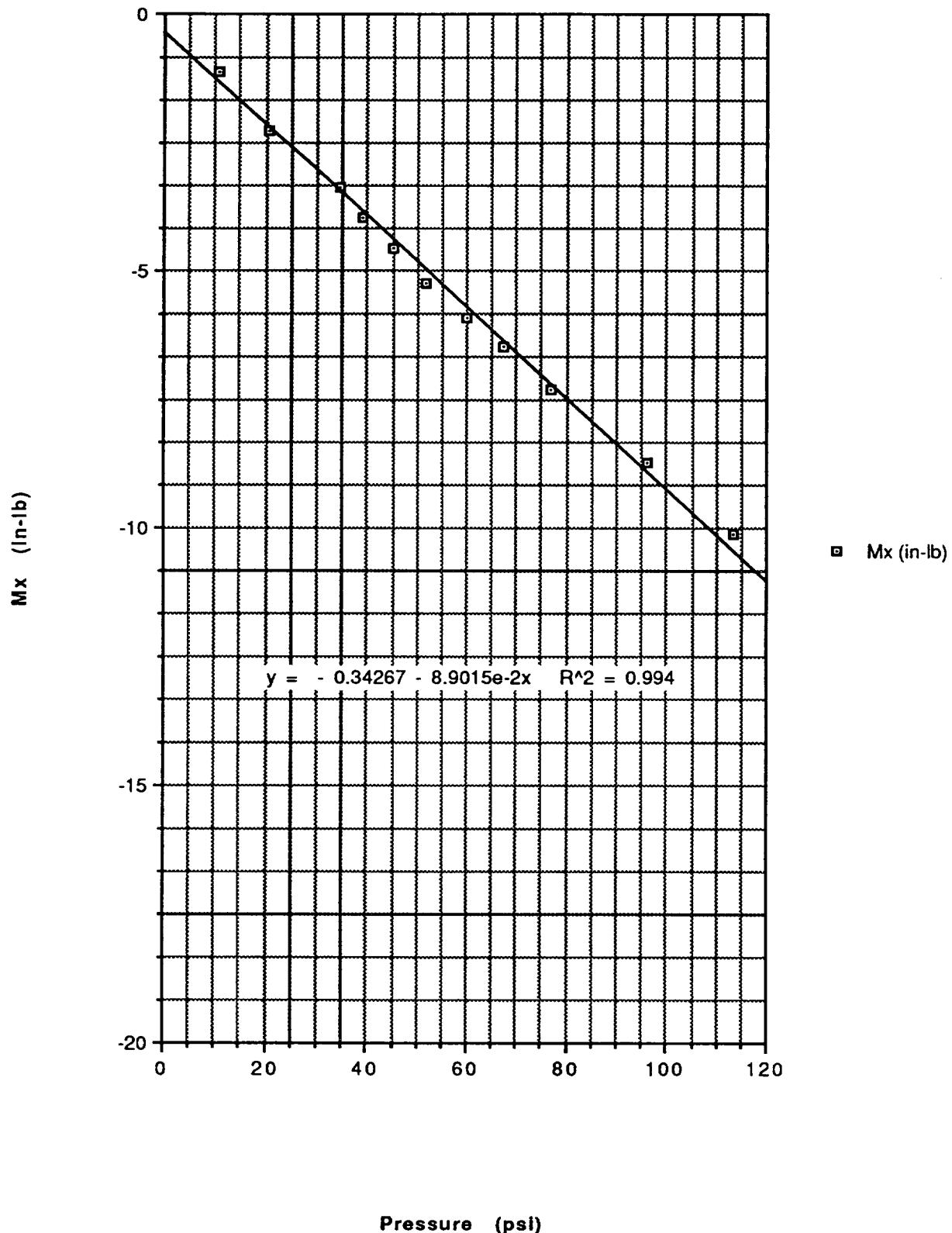
Data from "8/15/91 Plug Data"



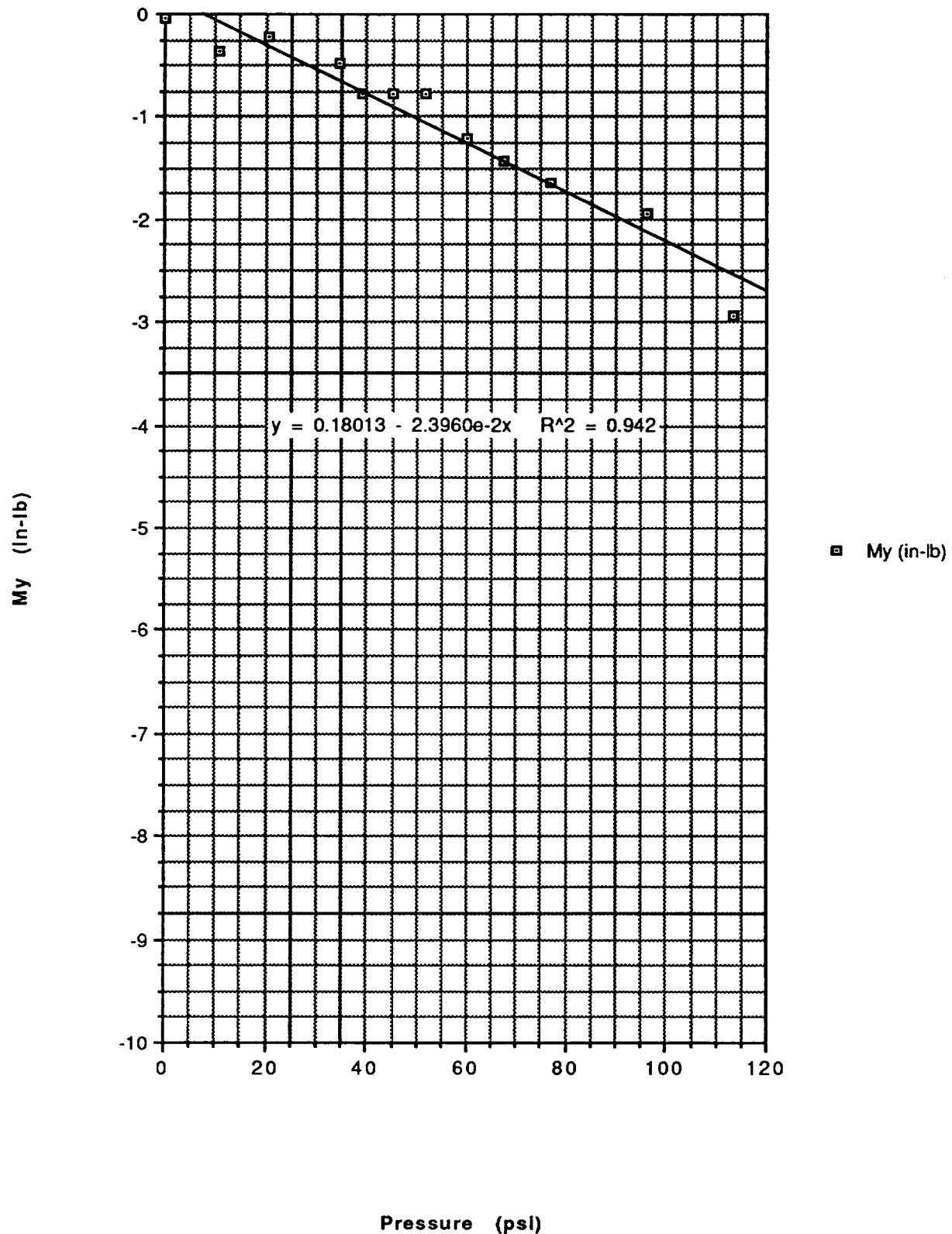
**Data from "8/15/91 Plug Data"**



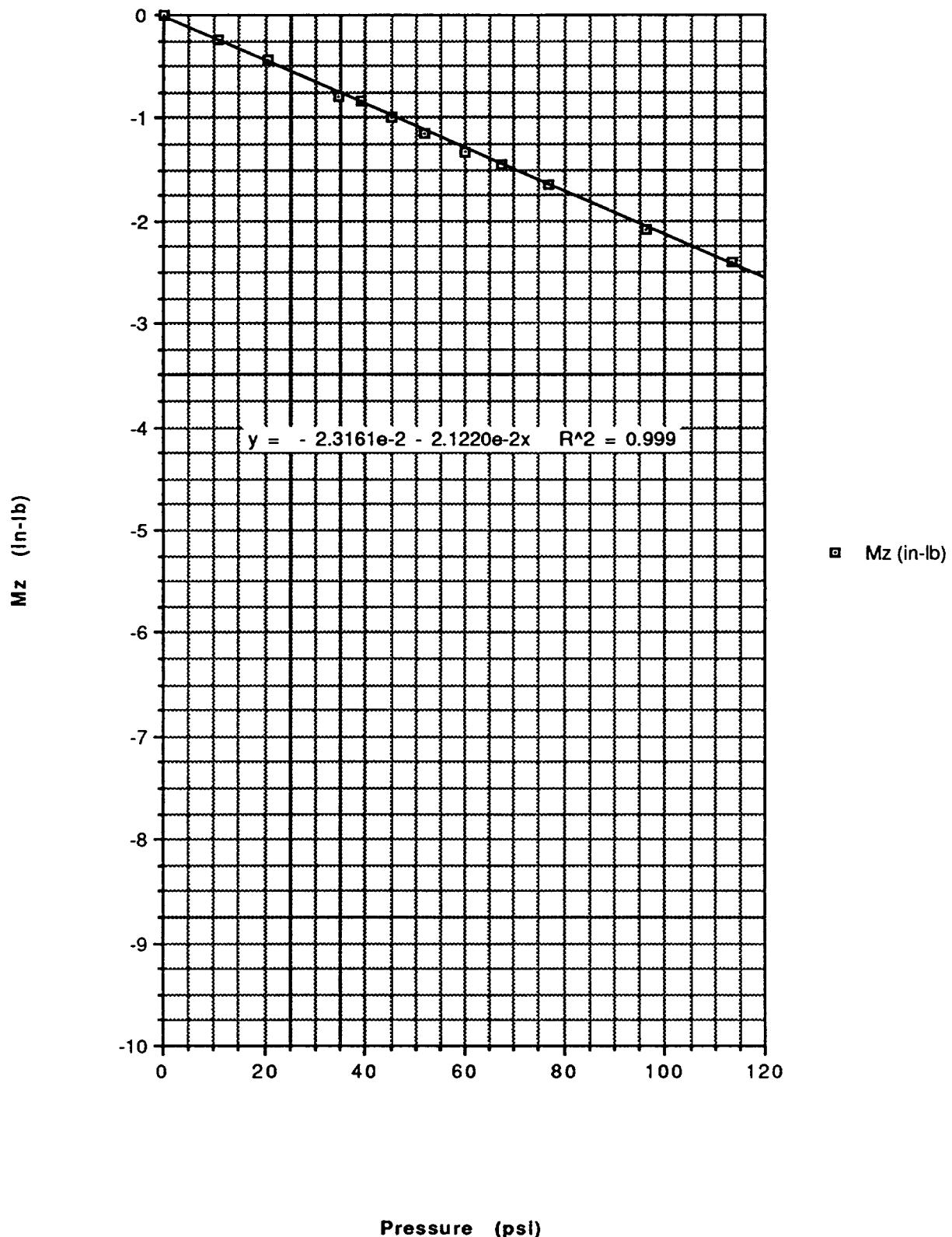
**Data from "8/15/91 Plug Data"**



**Data from "8/15/91 Plug Data"**



**Data from "8/15/91 Plug Data"**



8/15/91 Plug Data

Thu, Aug 15, 1991 2:29 PM

Pressure (psi)	Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (in-lb)	My (in-lb)	Mz (in-lb)
1	0.000	0.000	0.000	0.030	-0.040	0.000
2	10.800	0.020	-0.120	-0.070	-1.100	-0.350
3	20.700	0.050	-0.210	-0.020	-2.280	-0.220
4	34.500	0.070	-0.340	-0.090	-3.380	-0.480
5	39.200	0.100	-0.370	-0.070	-3.950	-0.780
6	45.400	0.130	-0.430	-0.040	-4.550	-0.780
7	51.900	0.130	-0.490	-0.090	-5.250	-0.780
8	59.900	0.170	-0.570	-0.040	-5.900	-1.210
9	67.600	0.200	-0.640	-0.050	-6.480	-1.430
10	76.700	0.250	-0.730	-0.050	-7.300	-1.650
11	96.200	0.290	-0.920	-0.020	-8.730	-1.950
12	113.600	0.430	-1.120	-0.040	-10.100	-2.940

8/15/91 Plug Data

Thu, Aug 15, 1991 2:29 PM

	R1 (lbf)	R2 (lbf)	R3 (lbf)	R4 (lbf)	R5 (lbf)	R6 (lbf)
1	0.000	0.000	0.000	0.000	0.000	0.000
	-0.170	0.010	0.090	0.020	-0.030	-0.090
	-0.310	0.120	0.170	0.050	-0.050	-0.160
4	-0.480	0.140	0.250	0.070	-0.070	-0.270
5	-0.550	0.150	0.330	0.100	-0.080	-0.290
6	-0.620	0.200	0.380	0.130	-0.090	-0.340
7	-0.730	0.230	0.410	0.130	-0.100	-0.390
8	-0.800	0.240	0.520	0.170	-0.120	-0.450
9	-0.880	0.250	0.580	0.200	-0.140	-0.500
10	-0.990	0.280	0.660	0.250	-0.160	-0.570
11	-1.170	0.350	0.800	0.290	-0.200	-0.720
12	-1.360	0.320	1.000	0.430	-0.260	-0.860

Po 305

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:27 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.7	psig		
A	15*Press1	-2.8	psig		
A	16*Press2	-1.7	psig		
A	17*R1	26.91	lbf		
A	18*R2	-23.86	lbf		
A	19*R3	25.49	lbf		
A	20*R4	0.48	lbf		
A	21*R5	0.97	lbf		
A	22*R6	2.19	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:27 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.7	psig		
A	15*Press1	-2.8	psig		
A	16*Press2	-1.7	psig		
A	17*R1	26.91	lbf		
A	18*R2	-23.87	lbf		
A	19*R3	25.49	lbf		
A	20*R4	0.48	lbf		
A	21*R5	0.97	lbf		
A	22*R6	2.19	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

*PI*

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:27 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.91	lbf		
A18*R2	-23.87	lbf		
A19*R3	25.49	lbf		
A20*R4	0.48	lbf		
A21*R5	0.97	lbf		
A22*R6	2.19	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:29 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*pressure 1	7.9	psig		
A 8*pressure 2	9.1	psig		
A15*Press1	8.1	psig		
A16*Press2	9.2	psig		
A17*R1	26.74	lbf		
A18*R2	-23.86	lbf		
A19*R3	25.58	lbf		
A20*R4	0.50	lbf		
A21*R5	0.94	lbf		
A22*R6	2.10	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P2

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:30 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.91	lbf		
A18*R2	-23.91	lbf		
A19*R3	25.47	lbf		
A20*R4	0.48	lbf		
A21*R5	0.97	lbf		
A22*R6	2.18	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:31 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	17.8	psig		
A 8*Pressure 2	19.0	psig		
A15*Press1	17.8	psig		
A16*Press2	19.0	psig		
A17*R1	26.60	lbf		
A18*R2	-23.79	lbf		
A19*R3	25.64	lbf		
A20*R4	0.53	lbf		
A21*R5	0.92	lbf		
A22*R6	2.02	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P3

\* ~ 8/15/91

\*\*\*\*\* Record 01:32 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A 7*	Pressure 1	-2.8	psig		
A 8*	Pressure 2	-1.7	psig		
A15*	Press1	-2.6	psig		
A16*	Press2	-1.5	psig		
A17*	R1	26.87	lbf		
A18*	R2	-23.88	lbf		
A19*	R3	25.45	lbf		
A20*	R4	0.48	lbf		
A21*	R5	0.97	lbf		
A22*	R6	2.17	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:36 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

me	Value	Unit	Alarm	messages
A 7*	Pressure 1	31.7	psig	
A 8*	Pressure 2	32.8	psig	
A15*	Press1	31.7	psig	
A16*	Press2	32.9	psig	
A17*	R1	26.39	lbf	
A18*	R2	-23.74	lbf	
A19*	R3	25.70	lbf	
A20*	R4	0.55	lbf	
A21*	R5	0.90	lbf	
A22*	R6	1.90	lbf	

ORIGINAL PAGE IS  
OF POOR QUALITY

P4

\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:36 - 00-Jan-72

( identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.7	psig		
15*Press1	-2.8	psig		
16*Press2	-1.7	psig		
17*R1	26.89	lbf		
18*R2	-23.92	lbf		
19*R3	25.39	lbf		
20*R4	0.47	lbf		
21*R5	0.96	lbf		
22*R6	2.15	lbf		

\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:38 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	36.3	psig		
8*Pressure 2	37.5	psig		
15*Press1	36.4	psig		
16*Press2	37.6	psig		
17*R1	26.34	lbf		
18*R2	-23.77	lbf		
19*R3	25.72	lbf		
20*R4	0.57	lbf		
21*R5	0.88	lbf		
22*R6	1.86	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

PS

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:39 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.9	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.88	lbf		
A18*R2	-23.93	lbf		
A19*R3	25.36	lbf		
A20*R4	0.47	lbf		
A21*R5	0.96	lbf		
A22*R6	2.15	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:41 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	42.5	psig		
A 8*Pressure 2	43.7	psig		
A15*Press1	42.5	psig		
A16*Press2	43.7	psig		
A17*R1	26.26	lbf		
A18*R2	-23.73	lbf		
A19*R3	25.74	lbf		
A20*R4	0.60	lbf		
A21*R5	0.87	lbf		
A22*R6	1.81	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P6

\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:41 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	-2.8	psig		
8*Pressure 2	-1.7	psig		
15*Press1	-2.9	psig		
16*Press2	-1.7	psig		
17*R1	26.88	lbf		
18*R2	-23.92	lbf		
19*R3	25.33	lbf		
20*R4	0.47	lbf		
21*R5	0.96	lbf		
22*R6	2.14	lbf		

\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:45 - 00-Jan-72

System identification data

Process parameter list

\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
7*Pressure 1	49.0	psig		
Pressure 2	50.2	psig		
15*Press1	49.0	psig		
16*Press2	50.2	psig		
17*R1	26.15	lbf		
18*R2	-23.69	lbf		
19*R3	25.74	lbf		
20*R4	0.60	lbf		
21*R5	0.86	lbf		
22*R6	1.75	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P7

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:46 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.9	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.7	psig		
A17*R1	26.87	lbf		
A18*R2	-23.90	lbf		
A19*R3	25.29	lbf		
A20*R4	0.47	lbf		
A21*R5	0.96	lbf		
A22*R6	2.13	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:48 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A Pressure 1	56.9	psig		
A 8*Pressure 2	58.2	psig		
A15*Press1	56.9	psig		
A16*Press2	58.2	psig		
A17*R1	26.07	lbf		
A18*R2	-23.66	lbf		
A19*R3	25.81	lbf		
A20*R4	0.64	lbf		
A21*R5	0.84	lbf		
A22*R6	1.68	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

78

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:49 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	-2.9	psig		
A8*Pressure 2	-1.8	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.7	psig		
A17*R1	26.85	lbf		
A18*R2	-23.91	lbf		
A19*R3	25.26	lbf		
A20*R4	0.47	lbf		
A21*R5	0.96	lbf		
A22*R6	2.12	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:51 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A7*Pressure 1	64.6	psig		
A8*Pressure 2	65.8	psig		
A15*Press1	64.7	psig		
A16*Press2	65.9	psig		
A17*R1	25.97	lbf		
A18*R2	-23.66	lbf		
A19*R3	25.84	lbf		
A20*R4	0.67	lbf		
A21*R5	0.82	lbf		
A22*R6	1.62	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

Pg

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:51 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.9	psig		
A 8*Pressure 2	-1.8	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.8	psig		
A17*R1	26.86	lbf		
A18*R2	-23.92	lbf		
A19*R3	25.23	lbf		
A20*R4	0.47	lbf		
A21*R5	0.96	lbf		
A22*R6	2.12	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:52 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	73.7	psig		
A 8*Pressure 2	74.9	psig		
A15*Press1	73.8	psig		
A16*Press2	75.1	psig		
A17*R1	25.87	lbf		
A18*R2	-23.64	lbf		
A19*R3	25.89	lbf		
A20*R4	0.72	lbf		
A21*R5	0.80	lbf		
A22*R6	1.55	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P/10

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:53 - 00-Jan-72

{ System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
4 7*Pressure 1	-2.9	psig		
4 8*Pressure 2	-1.8	psig		
415*Press1	-2.9	psig		
416*Press2	-1.8	psig		
417*R1	26.85	lbf		
418*R2	-23.92	lbf		
419*R3	25.21	lbf		
420*R4	0.46	lbf		
421*R5	0.96	lbf		
422*R6	2.12	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:55 - 00-Jan-72

{ System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
4 Pressure 1	93.1	psig		
4 8 Pressure 2	94.4	psig		
415*Press1	93.2	psig		
416*Press2	94.5	psig		
417*R1	25.68	lbf		
418*R2	-23.57	lbf		
419*R3	26.01	lbf		
420*R4	0.75	lbf		
421*R5	0.76	lbf		
422*R6	1.40	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

P11

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:55 - 00-Jan-72

{ identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.9	psig		
A 8*Pressure 2	-1.8	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.8	psig		
A17*R1	26.88	lbf		
A18*R2	-23.92	lbf		
A19*R3	25.17	lbf		
A20*R4	0.45	lbf		
A21*R5	0.96	lbf		
A22*R6	2.12	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:56 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

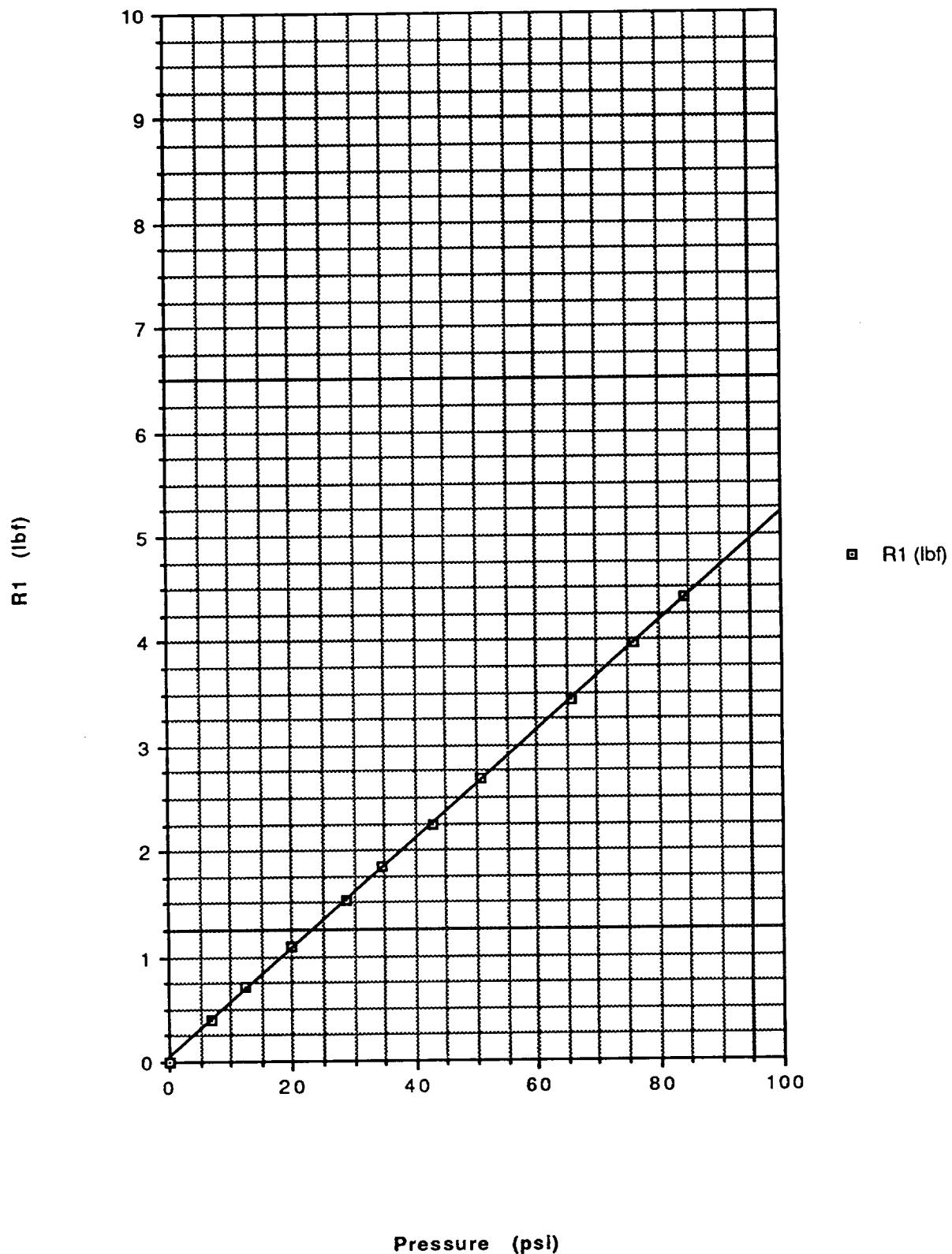
# Name	Value	Unit	Alarm	messages
A . Pressure 1	110.5	psig		
A 8*Pressure 2	111.8	psig		
A15*Press1	110.5	psig		
A16*Press2	111.8	psig		
A17*R1	25.52	lbf		
A18*R2	-23.60	lbf		
A19*R3	26.17	lbf		
A20*R4	0.88	lbf		
A21*R5	0.70	lbf		
A22*R6	1.26	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

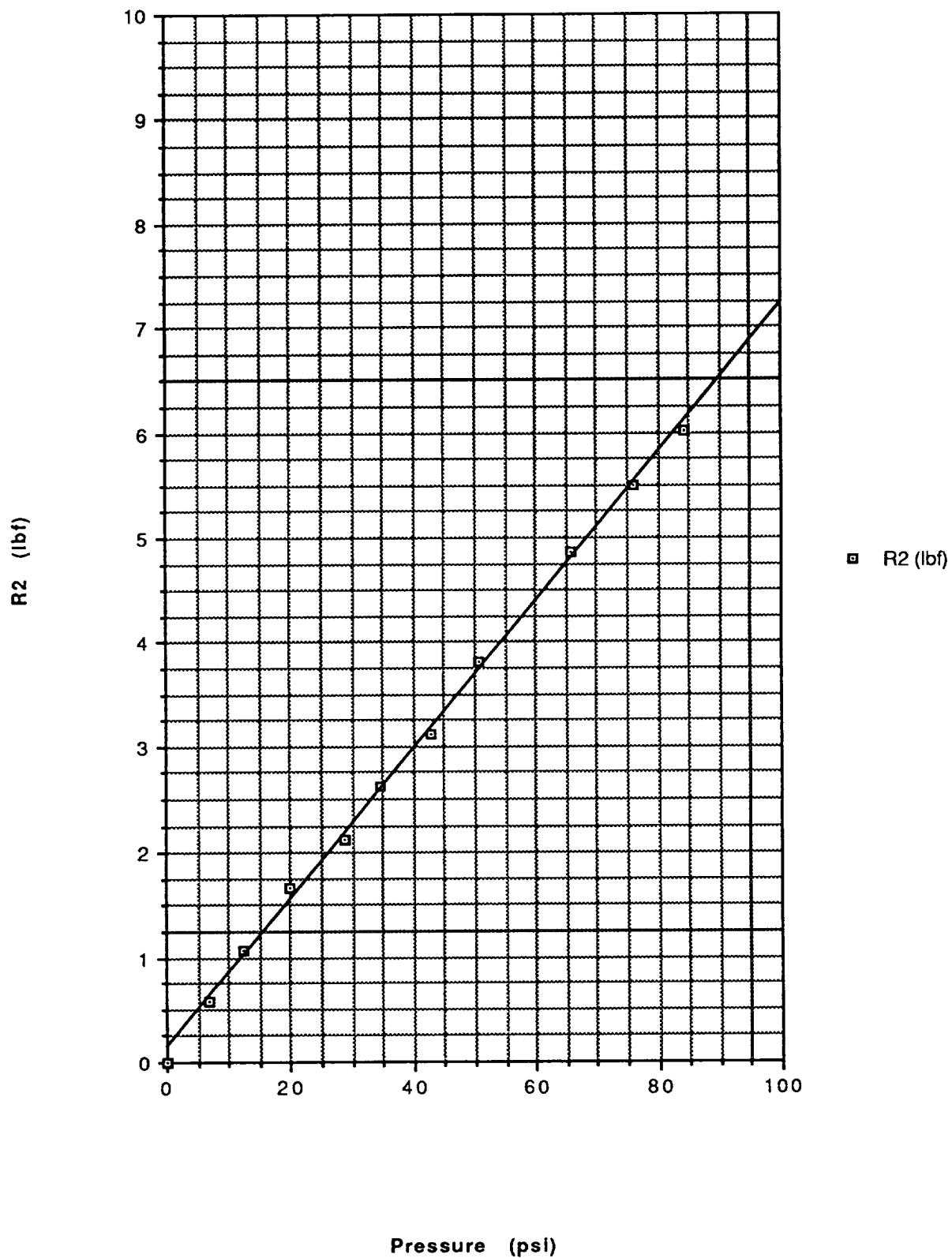
## APPENDIX H

8/15/91 STRAIGHT NOZZLE DATA

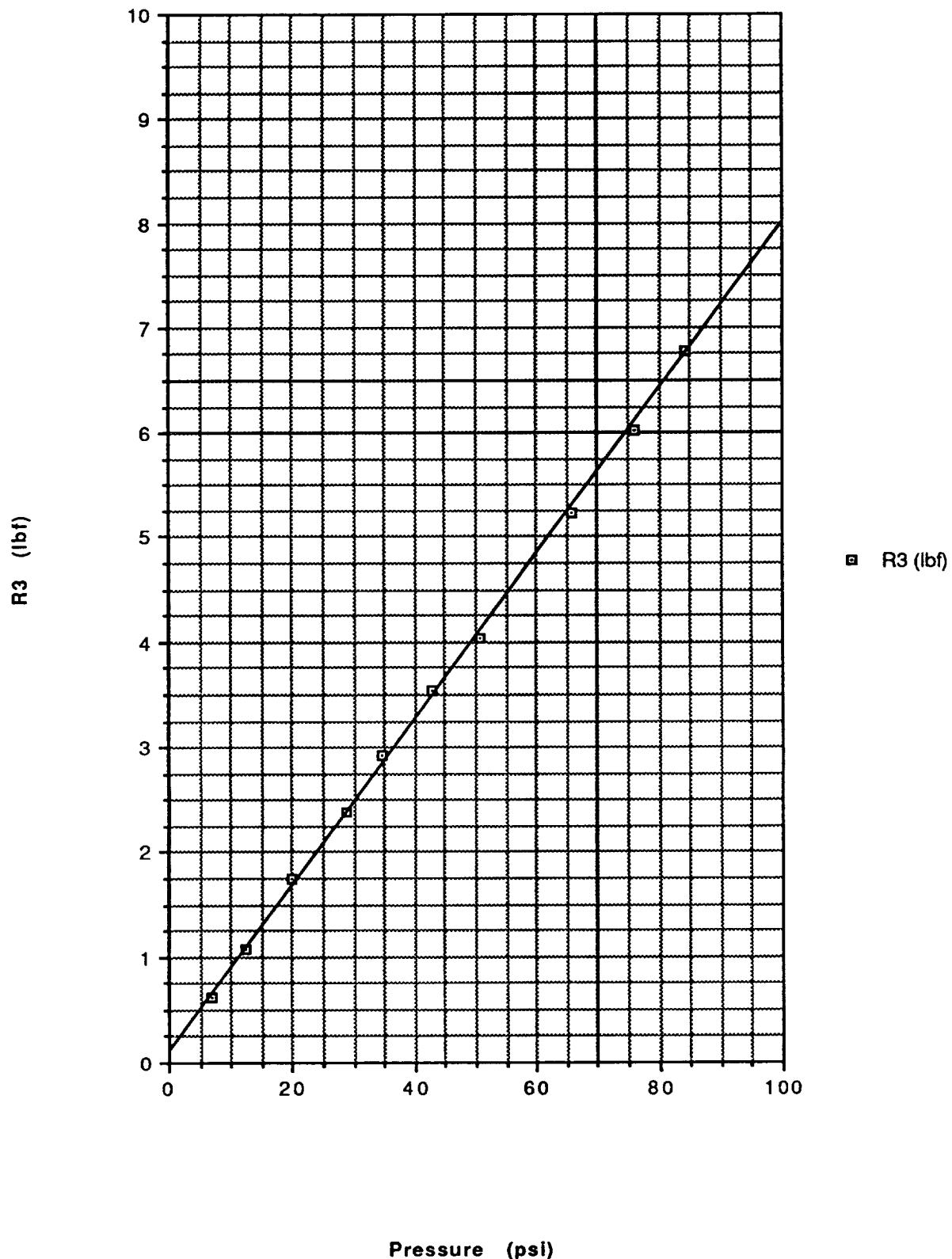
**Data from "8/15/91 Straight Data"**



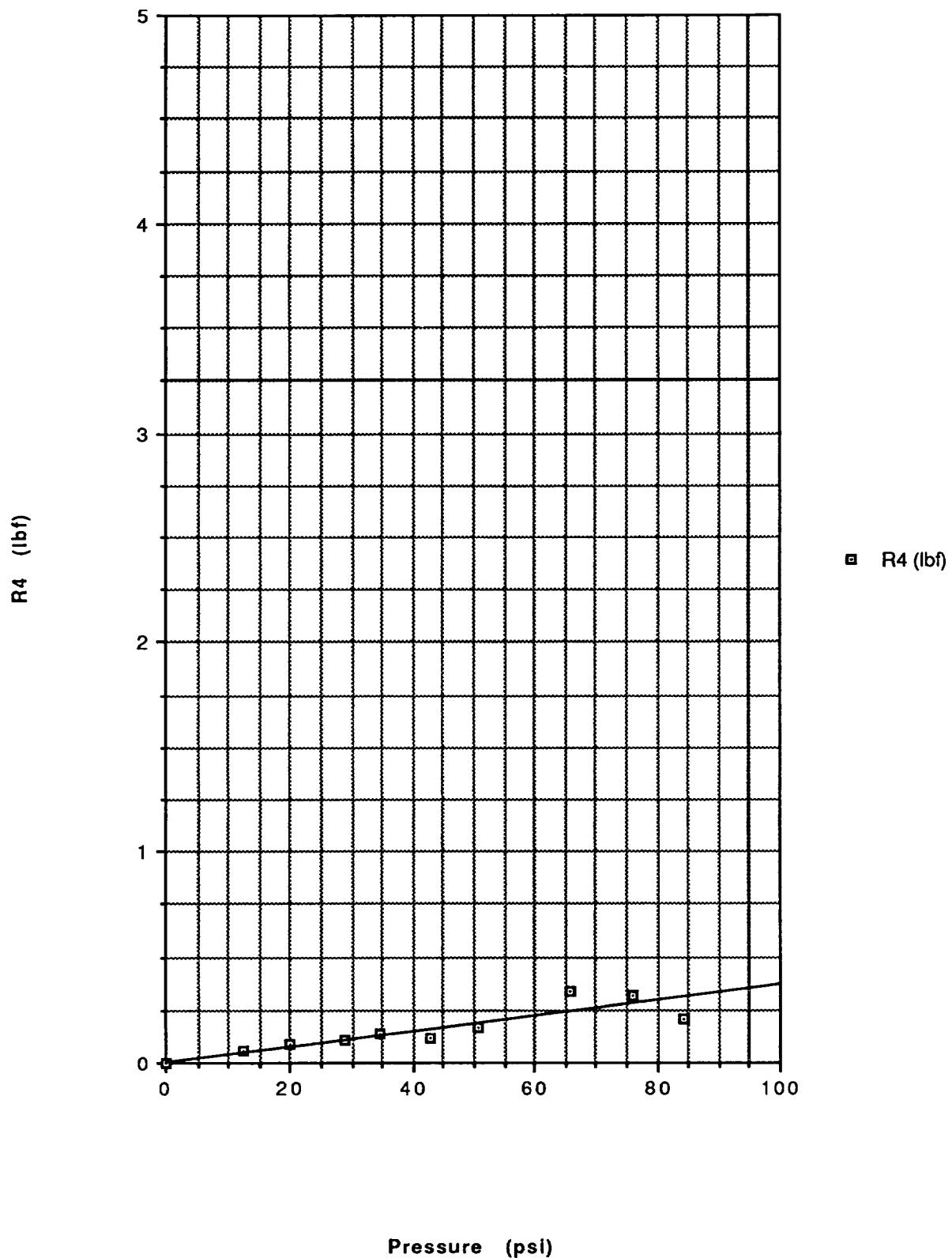
**Data from "8/15/91 Straight Data"**



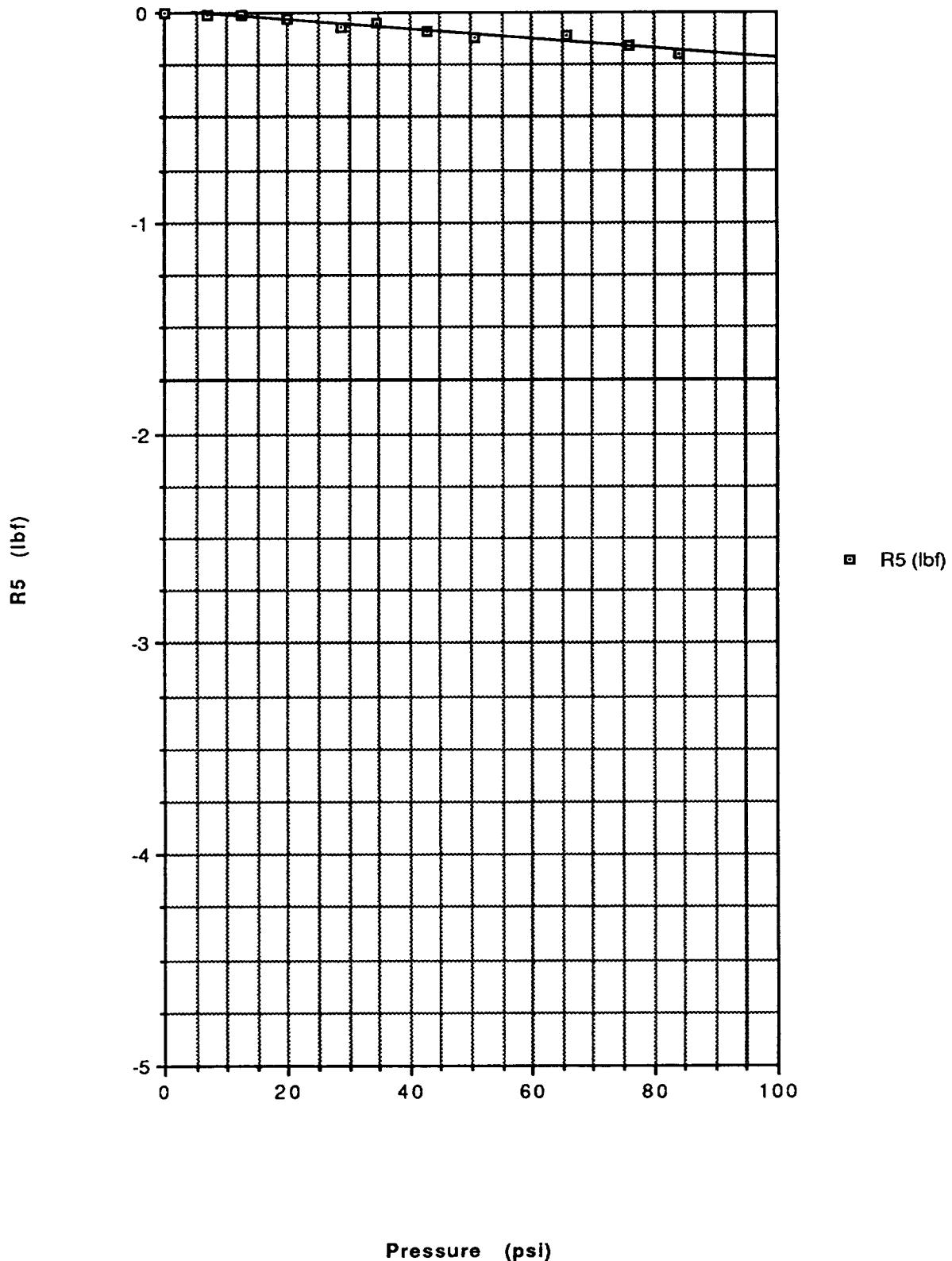
**Data from "8/15/91 Straight Data"**



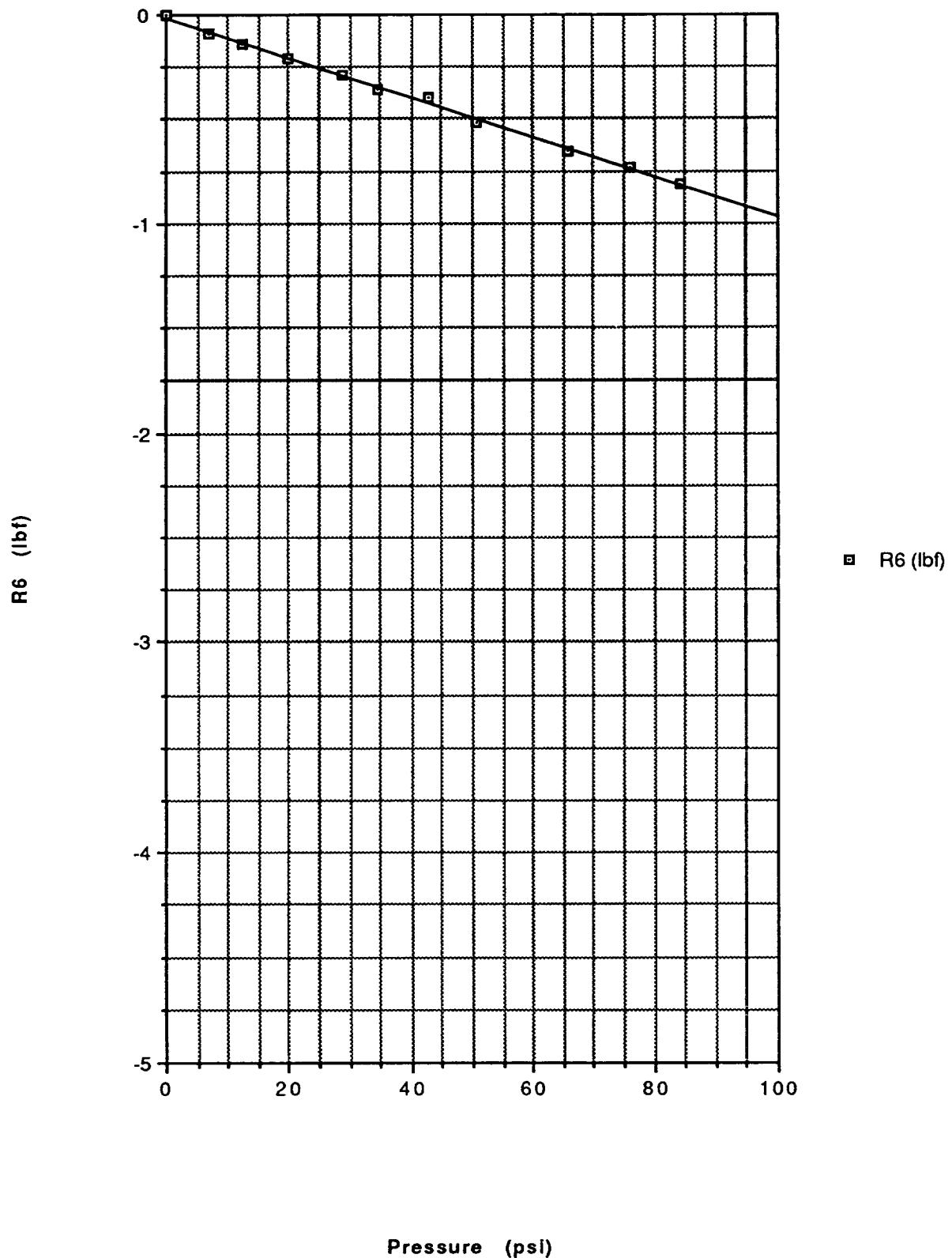
**Data from "8/15/91 Straight Data"**



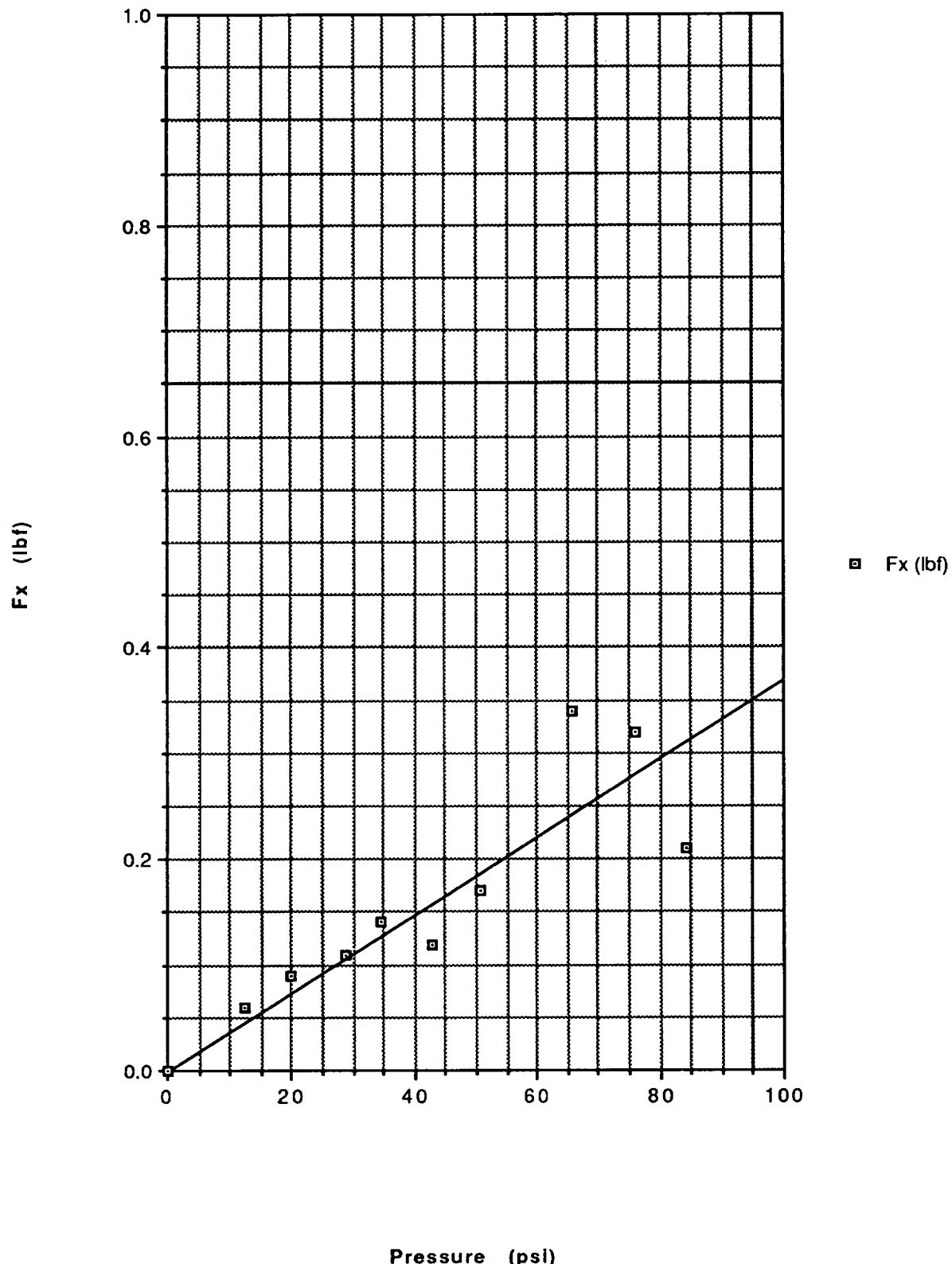
**Data from "8/15/91 Straight Data"**



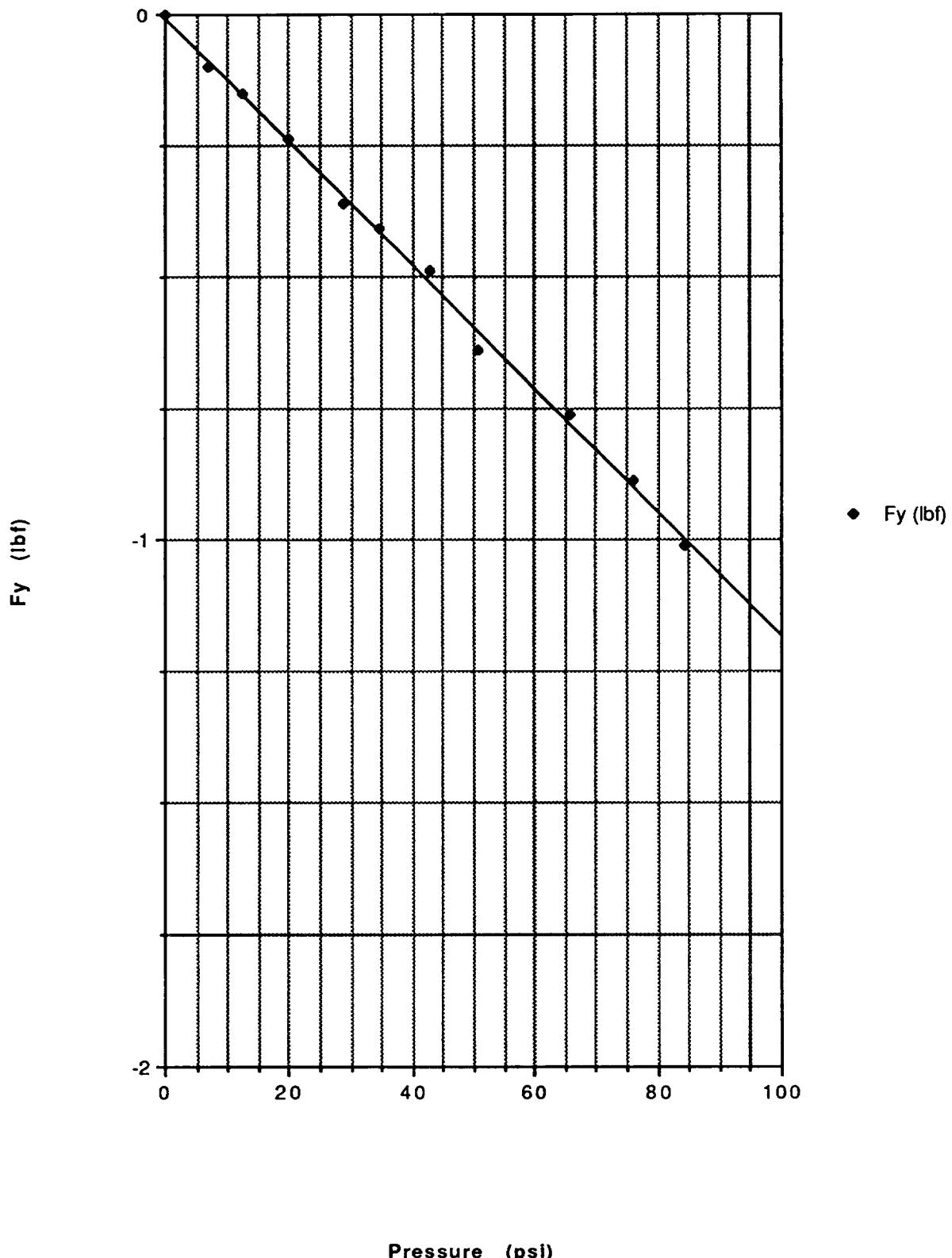
**Data from "8/15/91 Straight Data"**



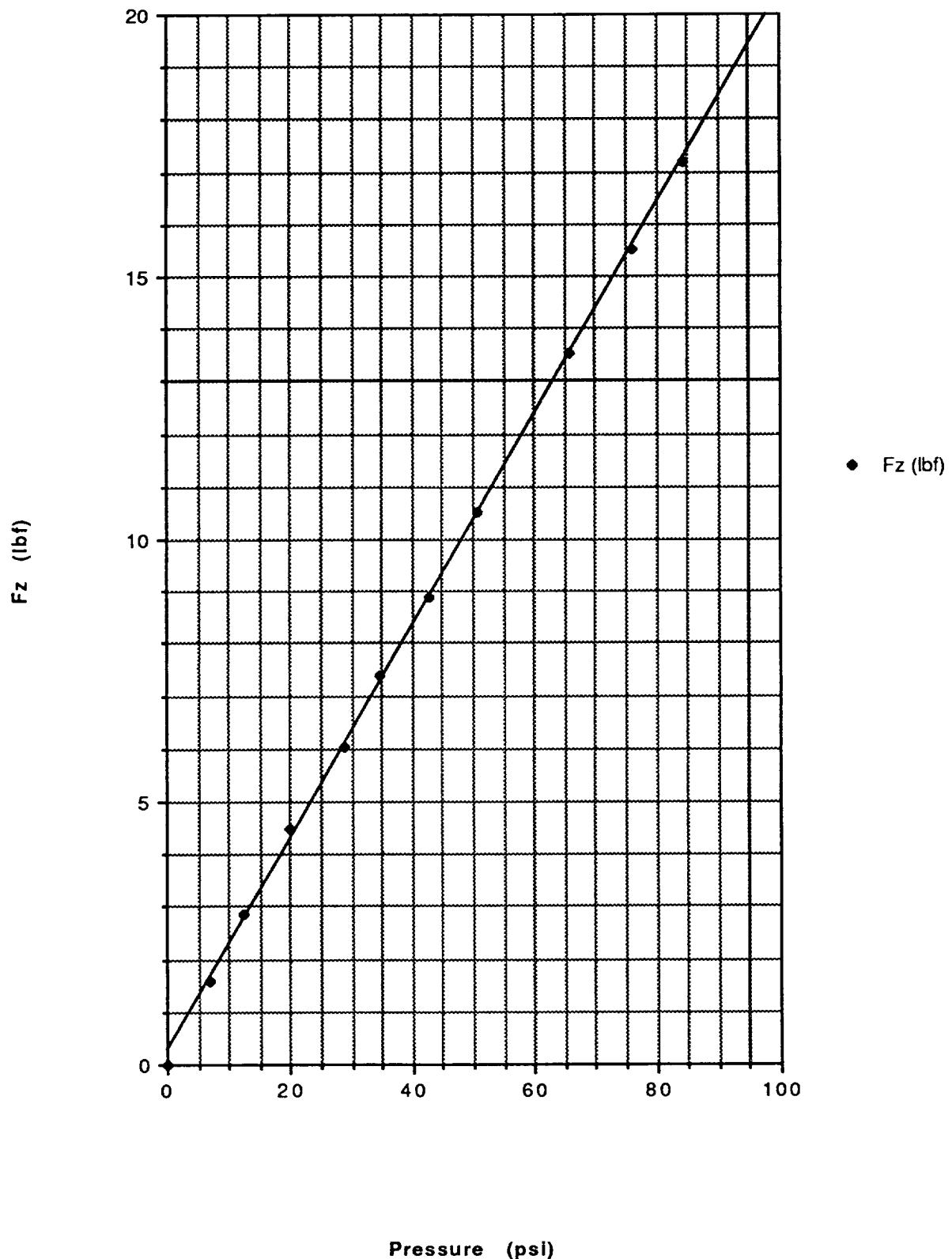
**Data from "8/15/91 Straight Data"**



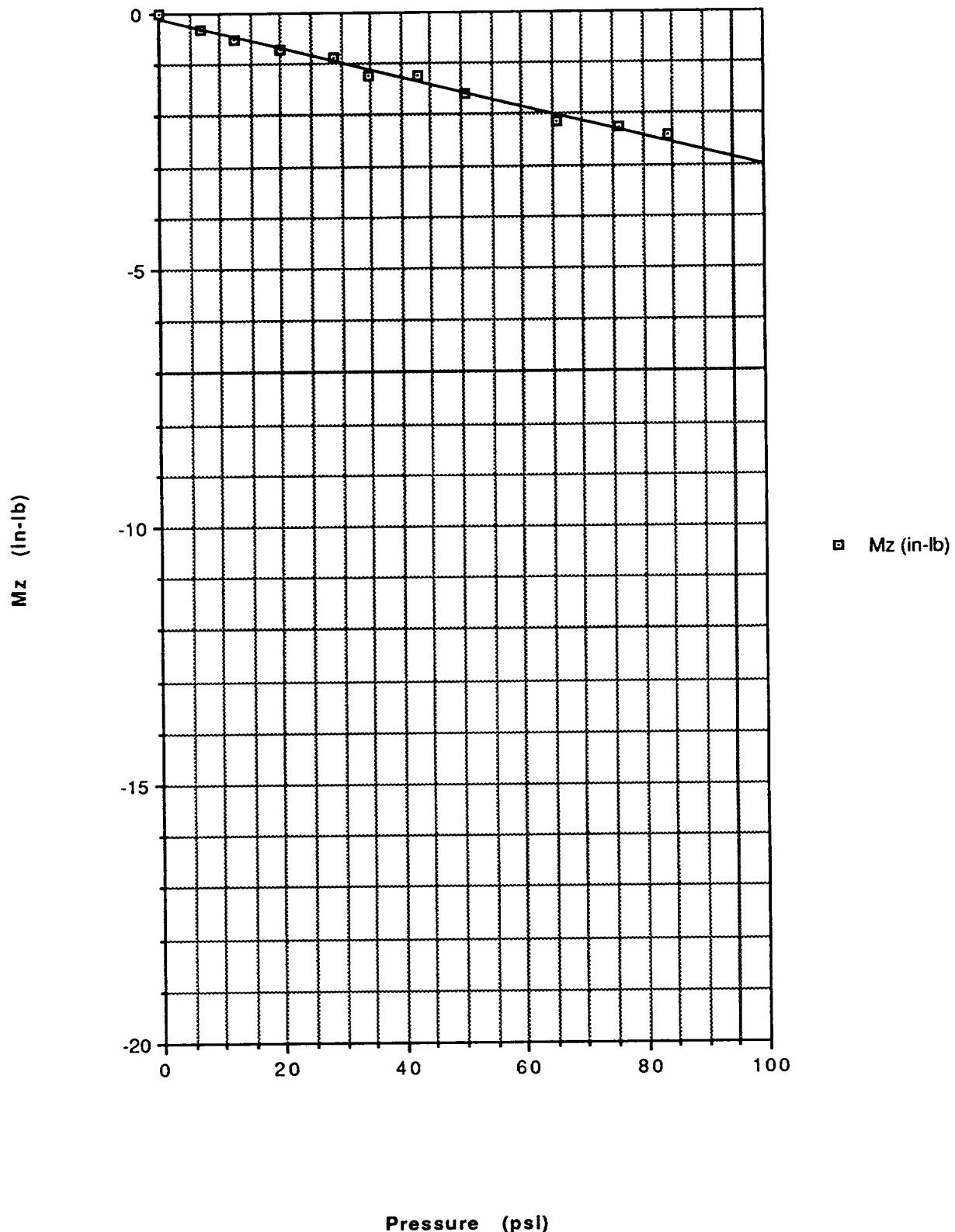
**Data from "8/15/91 Straight Data"**



**Data from "8/15/91 Straight Data"**



**Data from "8/15/91 Straight Data"**



8/15/91 Straight Data

Thu, Aug 15, 1991 2:29 PM

	R1 (lbf)	R2 (lbf)	R3 (lbf)	R4 (lbf)	R5 (lbf)	R6 (lbf)
1	0.000	0.000	-0.010	0.000	0.000	0.000
2	0.400	0.580	0.620	-0.030	-0.010	-0.090
3	0.720	1.070	1.080	0.060	-0.010	-0.140
4	1.100	1.660	1.740	0.090	-0.030	-0.210
5	1.520	2.130	2.390	0.110	-0.070	-0.290
6	1.850	2.610	2.930	0.140	-0.050	-0.360
7	2.240	3.120	3.530	0.120	-0.090	-0.400
8	2.680	3.800	4.040	0.170	-0.120	-0.520
9	3.440	4.860	5.230	0.340	-0.110	-0.650
10	3.970	5.500	6.030	0.320	-0.160	-0.730
11	4.400	6.020	6.780	0.210	-0.200	-0.810

8/15/91 Straight Data

Thu, Aug 15, 1991 2:29 PM

Pressure (psi)	Fx (lbf)	Fy (lbf)	Fz (lbf)	Mx (in-lb)	My (in-lb)	Mz (in-lb)
	0.000	0.000	0.000	-0.010	0.030	0.040
3	6.900	-0.030	-0.100	1.600	-1.000	-0.170
4	12.400	0.060	-0.150	2.870	-1.780	-0.040
5	19.700	0.090	-0.240	4.500	-3.000	-0.350
6	28.700	0.110	-0.360	6.040	-3.700	-1.130
7	34.700	0.140	-0.410	7.390	-4.600	-1.390
8	42.700	0.120	-0.490	8.890	-5.430	-1.780
9	50.600	0.170	-0.640	10.520	-6.200	-1.040
10	65.800	0.340	-0.760	13.530	-8.030	-1.600
11	76.000	0.320	-0.890	15.500	-8.980	-2.290
	84.400	0.210	-1.010	17.200	-10.000	-3.290
						-2.440

381

SD

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:09 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.6	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.6	psig		
A17*R1	26.88	lbf		
A18*R2	-23.86	lbf		
A19*R3	25.71	lbf		
A20*R4	0.45	lbf		
A21*R5	0.98	lbf		
A22*R6	2.24	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:09 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.6	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.6	psig		
A17*R1	26.88	lbf		
A18*R2	-23.87	lbf		
A19*R3	25.70	lbf		
A20*R4	0.45	lbf		
A21*R5	0.98	lbf		
A22*R6	2.24	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

51

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:10 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.6	psig		
A	15*Press1	-2.8	psig		
A	16*Press2	-1.6	psig		
A	17*R1	26.89	lbf		
A	18*R2	-23.87	lbf		
A	19*R3	25.70	lbf		
A	20*R4	0.45	lbf		
A	21*R5	0.98	lbf		
A	22*R6	2.24	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:11 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	Pressure 1	6.9	psig		
A	Pressure 2	5.3	psig		
A	15*Press1	7.0	psig		
A	16*Press2	5.4	psig		
A	17*R1	27.29	lbf		
A	18*R2	-23.29	lbf		
A	19*R3	26.32	lbf		
A	20*R4	0.42	lbf		
A	21*R5	0.97	lbf		
A	22*R6	2.15	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:12 - 00-Jan-72

SS

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.6	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.6	psig		
A17*R1	26.86	lbf		
A18*R2	-23.90	lbf		
A19*R3	25.66	lbf		
A20*R4	0.45	lbf		
A21*R5	0.97	lbf		
A22*R6	2.23	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:12 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	13.7	psig		
A 8*Pressure 2	10.8	psig		
A15*Press1	13.7	psig		
A16*Press2	10.7	psig		
A17*R1	27.58	lbf		
A18*R2	-22.83	lbf		
A19*R3	26.74	lbf		
A20*R4	0.51	lbf		
A21*R5	0.96	lbf		
A22*R6	2.09	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

59

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:13 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.6	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.6	psig		
A17*R1	26.85	lbf		
A18*R2	-23.91	lbf		
A19*R3	25.62	lbf		
A20*R4	0.44	lbf		
A21*R5	0.97	lbf		
A22*R6	2.23	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:13 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

C Pressure 1	22.5	psig		
A Pressure 2	18.1	psig		
A15*Press1	22.5	psig		
A16*Press2	18.2	psig		
A17*R1	27.95	lbf		
A18*R2	-22.25	lbf		
A19*R3	27.36	lbf		
A20*R4	0.53	lbf		
A21*R5	0.94	lbf		
A22*R6	2.02	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:16 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	7*Pressure 1	-2.8	psig		
A	8*Pressure 2	-1.7	psig		
A	15*Press1	-2.8	psig		
A	16*Press2	-1.7	psig		
A	17*R1	26.88	lbf		
A	18*R2	-23.86	lbf		
A	19*R3	25.64	lbf		
A	20*R4	0.46	lbf		
A	21*R5	0.98	lbf		
A	22*R6	2.22	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:17 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

#	Name	Value	Unit	Alarm	messages
A	7*Pressure 1	32.7	psig		
A	8*Pressure 2	27.0	psig		
A	15*Press1	32.9	psig		
A	16*Press2	27.0	psig		
A	17*R1	28.40	lbf		
A	18*R2	-21.73	lbf		
A	19*R3	28.03	lbf		
A	20*R4	0.57	lbf		
A	21*R5	0.91	lbf		
A	22*R6	1.93	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

56

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:18 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.86	lbf		
A18*R2	-23.89	lbf		
A19*R3	25.60	lbf		
A20*R4	0.46	lbf		
A21*R5	0.97	lbf		
A22*R6	2.21	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:18 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	39.8	psig		
A 8*Pressure 2	33.0	psig		
A15*Press1	40.0	psig		
A16*Press2	33.1	psig		
A17*R1	28.71	lbf		
A18*R2	-21.28	lbf		
A19*R3	28.53	lbf		
A20*R4	0.60	lbf		
A21*R5	0.92	lbf		
A22*R6	1.85	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

57

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:19 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.85	lbf		
A18*R2	-23.90	lbf		
A19*R3	25.59	lbf		
A20*R4	0.46	lbf		
A21*R5	0.98	lbf		
A22*R6	2.21	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:20 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name Value Unit Alarm messages

A Pressure 1	49.2	psig		
A Pressure 2	41.0	psig		
A15*Press1	49.1	psig		
A16*Press2	40.9	psig		
A17*R1	29.09	lbf		
A18*R2	-20.78	lbf		
A19*R3	29.12	lbf		
A20*R4	0.58	lbf		
A21*R5	0.89	lbf		
A22*R6	1.81	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

58

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:20 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.85	lbf		
A18*R2	-23.93	lbf		
A19*R3	25.57	lbf		
A20*R4	0.46	lbf		
A21*R5	0.97	lbf		
A22*R6	2.21	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:22 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
P Pressure 1	58.5	psig		
P Pressure 2	48.9	psig		
A15*Press1	58.7	psig		
A16*Press2	49.2	psig		
A17*R1	29.53	lbf		
A18*R2	-20.13	lbf		
A19*R3	29.61	lbf		
A20*R4	0.63	lbf		
A21*R5	0.85	lbf		
A22*R6	1.69	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:22 - 00-Jan-72

## System identification data

## Process parameter list

7

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.8	psig		
A16*Press2	-1.7	psig		
A17*R1	26.85	lbf		
A18*R2	-23.91	lbf		
A19*R3	25.55	lbf		
A20*R4	0.46	lbf		
A21*R5	0.97	lbf		
A22*R6	2.20	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:23 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	75.9	psig		
A Pressure 2	64.1	psig		
A15*Press1	76.2	psig		
A16*Press2	64.2	psig		
A17*R1	30.29	lbf		
A18*R2	-19.05	lbf		
A19*R3	30.78	lbf		
A20*R4	0.80	lbf		
A21*R5	0.86	lbf		
A22*R6	1.55	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.8	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.7	psig		
A17*R1	26.84	lbf		
A18*R2	-23.91	lbf		
A19*R3	25.53	lbf		
A20*R4	0.43	lbf		
A21*R5	0.97	lbf		
A22*R6	2.20	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:24 - 00-Jan-72

## System identification data

## Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	87.8	psig		
A 8*Pressure 2	74.3	psig		
A15*Press1	87.8	psig		
A16*Press2	74.3	psig		
A17*R1	30.81	lbf		
A18*R2	-18.41	lbf		
A19*R3	31.56	lbf		
A20*R4	0.75	lbf		
A21*R5	0.81	lbf		
A22*R6	1.47	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

SII

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:25 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	-2.9	psig		
A 8*Pressure 2	-1.7	psig		
A15*Press1	-2.9	psig		
A16*Press2	-1.7	psig		
A17*R1	26.84	lbf		
A18*R2	-23.85	lbf		
A19*R3	25.52	lbf		
A20*R4	0.48	lbf		
A21*R5	0.97	lbf		
A22*R6	2.19	lbf		

\*\*\*\*\* 8/15/91

\*\*\*\*\* Record 01:25 - 00-Jan-72

System identification data

Process parameter list

\*\*\* Chan.data \*\*\*

# Name	Value	Unit	Alarm	messages
A 7*Pressure 1	97.5	psig		
A 8*Pressure 2	82.7	psig		
A15*Press1	97.5	psig		
A16*Press2	82.5	psig		
A17*R1	31.24	lbf		
A18*R2	-17.83	lbf		
A19*R3	32.30	lbf		
A20*R4	0.69	lbf		
A21*R5	0.77	lbf		
A22*R6	1.38	lbf		

ORIGINAL PAGE IS  
OF POOR QUALITY

## APPENDIX I

8/15/91 STATISTICAL DATA AND CALCULATIONS

SIMPLISTIC CIRCUMSTANCE

$P_1 = 8.57$

EQUATIONS USED

$M = \frac{1}{n} \sum_{i=1}^n x_i / n$

$\bar{x} = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}$

ST Dev .14

V AR .02

	$R_1$	$R_2$	$R_3$	$R_4$	$R_5$	$R_6$
$M$	.674	.353	.986	<del>.004</del> -.017	-0.124	-0.031
ST Dev	.0344	.04001	.03688	<del>.01505</del> 0.02584 <del>.00022</del> .0006678	0.00899	0.00995
V AR	.00118	.00160	.00136		.000049	0.000097

$P_2 = 24.63$

$ST Dev = 0.125166$

$= 0.01566$

- V AR

1.797	.832	2.566	-.07	-.306	-0.32
.011595	.042635	.03035	.04807	0.00966	0.0137
.0001344	.001817	.00147	0.002311	.0000933	0.0000

$P_3 = 41.08$

$ST Dev = .2499$

$\sqrt{ } = 0.047622$

$\approx 0.047622$

2.706	1.226	1.101	-0.19	-0.476	-0.095
0.01577	.23434	0.04358	0.0616	.010749	0.09675
0.0002489	.054915	0.001899	0.0038	.00011556	0.009361